MODELING SUPPLY CHAIN RISKS AND WAYS TO AMELIORATE NEGATIVE EFFECTS ON THE SUPPLY CHAIN PERFORMANCE AND REPUTATION OF FIRM IN THE DAIRY INDUSTRY

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ABSTRACT - Supply chain risk has become an issue of significance for many dairy firms across the globe. The complexity of the supply chain has increased due to various levels of raw material sourcing, uncertain market conditions, competition and ever changing customer demands. The aim of this literature-based study is to investigate how the literature suggests supply chain risks are approached in a dairy industry and the methods that have been found to mitigate or ameliorate negative impacts of events that compromise supply chain performance and reputation of firm. A conceptual framework for supply chain risk management is discussed for better handling of risks in a dairy supply chain. The main focus of the study will be on how supply chain risk management is approached in the literature, what are the various kinds of supply chain risks in a dairy industry, perception of supply chain risks in a dairy firms and its effects on the proper functioning of the firm, the role of trust, communication and relationship between supply chain partners as the main parameters for better handling of risks in a dairy supply chain. Importance is also given to understand what the existing literature suggests on ways to mitigate and ameliorate negative effects of risks for better supply chain performance and reputation of firm. These are some of the questions on which the research is built.

Comprehensive literature review along with case study analysis has been used as the main approach for data collection. A three stage research approach was used to answer the research questions. Stage one was focusing on the existing literature on supply chain risk management. Four cases (stage two) on supply chain failures in dairy firms are used to analyse the supply chain risks and how it could be managed well by the organization for a better performance and reputation of the firm. Finally, a matrix (stage three) is developed from the input received from the cases which is linked to the literature review on supply chain risk management and also explains how these risks can be ameliorated for a greater supply chain performance. Risk and uncertainties can obstruct the smooth flow of supply chain activities which has an effect on its performance. Proper identification and assessment of risk is of major importance in a proper supply chain risk management. Supply chain risk management is built on the foundation of trust, commitment, frequent information sharing and a perfect relationship.

Key words – Supply chain management, supply chain risks, risk management, performance management, dairy firm, Supply chain and communication, relationship and trust.

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CHAPTER - 1

INTRODUCTION

1.1 OVERVIEW OF THE CHAPTER

The chapter introduces the concept of supply chain and explains its importance in today's business scenarios. After stating the aim of the study, the other sections in this chapter deals with the definition of supply chain, different concepts related to supply chain and risk management, importance of risk management, the motivation behind doing such a study, highlights the research questions and explains the study's importance. The chapter concludes by outlining the whole research paper.

1.2 AIM OF THE STUDY

The aim of this literature-based study is to investigate how the literature suggests supply chain risks are approached in a dairy industry and the methods that have been found to mitigate or ameliorate negative impacts of events that compromise supply chain performance and reputation of firm. This review of the literature is used to discuss a model of risk management that is then used to examine four cases of supply chain breakdown in the dairy sector.

1.3 THE CONCEPTS OF SUPPLY CHAIN AND SUPPLY CHAIN MANAGEMENT

A supply chain can be defined as the network of organizations that are involved through the upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumers (Christopher, 1992; Mentzer et al, 2001). A supply chain is a system of organisations, people, activities, information and resources involved in moving a product or service from supplier to customer (Stock and Boyer, 2009; Wilson, 2005). Supply chain activities involve the transformation of natural resources, raw materials and components into a finished product that is delivered to the end customer (Pettit, Fiksel and Croxton, 2010). The supply chain network partner firms often become involved in supply chain management to integrate, planning, implementing and controlling the effective flow of goods and services, related information and associated funds for the purpose of meeting customer requirements

(Lambert and Cooper, 2000). Close co-operation helps supply chain members to effectively match demand and supply to increase overall supply chain profitability.

Upstream flow includes the raw material supply activities and downstream flow includes the finished products distribution activities. The supply chain includes a group of firms (supplier of raw materials, manufacturing firm, logistics firm, wholesaler and retailer) that carry forward the required materials to the final customer (La Londe and Masters, 1994). According to Jones and Riley (1985), supply chain includes the movement of goods from supplier of raw materials to the final customer. The focus of this study will be on the supply chain risks and how it affects the performance of supply chain activities and reputation of the firm.

Supply chain management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high performing business model (Stock and Boyer, 2009; Lambert and Cooper, 2000). The primary objective of supply chain management is to fulfil customer demands through the most efficient use of resources including distribution capacity, inventory and labour (Stock and Boyer, 2009). Supply chain risk management is aimed at managing risk in complex and dynamic supply and demand networks.

The concept of supply chain management came into prominence over the last fifteen years. It has become a vital consideration of any manufacturing firm as it includes considerations of distribution, transportation, customer relationship and marketing as their main activity (Ross, 2013). Global procurement, market uncertainty, constantly changing technology and increased competition are some of the reasons why the firms need to focus on supply chain management (Mentzer et al, 2001). A closer relationship between firm and their suppliers is considered desirable in order to ensure coordination and proper flow of information and knowledge. Providing the firm's customers with a quality product at an affordable rate and on time delivery in a better way than the competitors is a requirement for market success and it is here where supply chain further plays an important role. Developing good supply chain relationships with the suppliers helps when creating a corporate strategy and is likely to increase firm performance (Mentzer et al, 2001).

There are previous studies on the risk and its association with relationship, performance and how it affects the reputation of a firm in the manufacturing sector, agriculture, forestry and retail industry in general. We can find literature on risk related to supplier behavior and also related to competitors. There are also existing case studies on the risk and its relationship with the supply chain performance and firm reputation in the wine industry, mining industry and fishing industry. But very little study has been conducted on the risk and its effect on the supply chain performance and firm reputation in the dairy industry.

The principles and practices of supply chain parties are rapidly changing (Olhager and Selldin, 2004). These changes have an important role to play for the design of supply chain, how they are managed and controlled. The various ideas and information between the firm and supplier have to be transferred through proper communication which can lead to a perfect relationship and trust. At the supply chain interface, various information based on different situations are conveyed through different information and communication technologies (Olhager and Selldin, 2004) such as ERP softwares, demand forecasting tools, GPS, personal digital assistant and online truck movement software which can improve the supply chain operations.

A supply chain focus is necessary for the long term well being of any manufacturing firm. Proper understanding of the likely supply chain risks has an effect on the reputation of the firm and can be viewed as a value creation process where manufacturing firms require quality raw material at reduced costs which can create greater value for the final customer (Lockamy III and Smith, 2000). Supplier and manufacturing performance can be enhanced (Vonderembse and Tracey, 1999) through supplier involvement and support in the supply chain activities. The quality and performance of a product, the involvement dimensions of a supplier and their performance are positively correlated with manufacturing performance (Vonderembse and Tracey, 1999). For a greater supply chain performance and reputation, the manufacturing firm and the suppliers need to adapt to certain situation (Heide and John, 1988). Adaptation can be vital for the conduct of business, relationship maintenance and long term performance of partners.

In today's uncertain markets, supply chain risk has become an issue of significance for many dairy firms. A supply chain has become more complex as a result of global sourcing and

thereby increasing the risk. The risk can be managed and mitigated by creating a better resilient supply chain network. Over the past years, the notions about conventional logistics and purchasing roles in organisations have developed to embrace a more strategic perspective of raw material and distribution management.

New trends in product/services and intense competition have led to an increase in issues and risks in the supply chain activities. Firms need to assess the risk and manage them from different perspectives in order to be successful. Earlier, when production was less and target markets were small, the risk involved in the supply chain was comparatively lower than today. Increased production and the desire for greater growth, subsequently has increased the risk and issues in the supply chain. The firms adopting a global perspective have made the supply chain activities more vulnerable to international risks. The need to respond to ever changing market demand forces firms to have deeper relationships with its supply chain partners. The risk factor increases when the firms are more dependent on each other.

The literature review seeks to find out what is known about the risk related to supply chain in a dairy industry and the most appropriate methods to minimise it. A comprehensive review of the literature will be done to understand the supply chain risks that affect the dairy industry and how these risks affect the supply chain performance and the reputation of firm. Based on case studies and a comprehensive literature review a structural analysis will be developed. A preliminary review reveals that very little research has been carried out on how to effectively manage the risks in a dairy supply chain from a relationship and communication perspective. A wide range of research related to risk in purchasing and supply has been carried out in the past but the research related to risks in the supply chain activities and the methods to identify and manage that risk are comparatively less well studied. This is especially true for risk and its effect on the supply chain performance and the reputation of dairy industry.

Risk management has emerged as an important aspect of business decision making and for proper control (Giannakis et al, 2004; Mallman, 1996). Technological changes, search for competitive advantage and global competition are few of the motives behind firms focus on risk management approaches (Brindley, 2004). Firms perceive risk in different ways and the management of the perceived risk has an effect on the supply chain performance and on

the reputation of the firm. Supply chain managers need to recognize and manage risks by taking into consideration various conditions. Management of risks should be based on contexts such as in house manufacturing, local sourcing, product and service complexity and international supply chain activities.

Risk can be explained as a loss, damage, undesired result or a chance of danger. There are an infinite number of definitions for the term risk (Ritchie and Marshall, 1993). Risk can be defined as "The probability that a particular adverse event occurs during a stated period of time or results from a particular challenge" (Royal Society, 1992). It can also be defined as "The probability of loss and the significance of that loss to the organisation or individual" (Mitchell, 1995). Magnitude of losses, chance of loss and the potential exposure to loss were the three main parameters on which risk was defined by MacCrimmon and Wehrung (1986). Three components which are common in most of the risk definitions are probability of occurrence of a particular event, consequence of the particular event occurring and the pathway leading to the event (Ritchie and Brindley, 2007).

The need to respond to market changes made supply chain unavoidable. Collaboration and cooperation with supply chain partners had strengthen the relationship at the same time increase the risk factor as well. Cooperation between the supply chain network partners can challenge a proper management of risk. Dependency also has a role to play in the management of risk. When a particular firm is too much dependent on another network partner for its operations it is more exposed to the supply chain risk.

In my previous work in the marketing and distribution wing of a cement manufacturing industry, we had a tough time dealing with the supply chain issues and there was enormous risk when stepped into the global business arena. A delay in raw material supply can affect the whole business process. The reputation of the firm is badly influenced when met with a quality crisis or not meeting the standards of a particular country. Apart from that there were other issues like irregular information and communication, external pressure from media when hit with a crisis, difficulty in meeting the expectations of the network partners and too much dependence on certain logistics firms. In fact this was the motivation behind doing such a thesis.

Supply chain network has a number of benefits and opportunities such as focus on core skills, reduced transaction costs, sharing key technologies and advantage to enter untapped markets through local support. But it has its own demerits such as more exposure to international risk and too much dependence on a particular network partner. The risks that exist in a supply network, the risk management process, how the risks are differently perceived by the firms and how it affects the reputation and performance of the firm is further explained in the study. Focus of the study is mostly on the dairy industry and its supply networks.

This literature-based study will ask the following **research questions:**

- How can we analyse the process of mitigating and ameliorating supply chain risk in the dairy sector to capture the role of relationship, trust and communication in supply chain risk management?
    - What does the literature suggests about the different ways in which firms perceive the supply chain risk and what effect?
    - What are the various kinds of supply chain risks in a dairy industry and how does the literature propose these the risks be minimised for a better supply chain reputation and performance of the firm?
    - What can be learnt about supply chain risk management from past crises in the dairy industry?
    - How do trust, relationship and communication affect the perception of risk and management of it?

1.5 RESEARCH PAPER STRUCTURE

The current research paper contains six chapters with various sub divided sections. The first chapter on introduction deals with the aim of the study, definition and various concepts related to supply chain and risk management, highlights the research questions and also explains the importance of the study. Chapter two examines and discusses the various approaches undertaken to do the study. The two approaches used to gather information are

comprehensive review of literature and case study analysis. A description about the three stage research approach used for this particular study has also been mentioned.

Chapter three presents the review of existing literature. It examines prior literature related to supply chain of a dairy industry, supply chain and its link with risk, supply chain performance and risk management, role of trust, relationship and communication for better handling of risks in a supply chain. The chapter develops and explains a conceptual framework for proper supply chain risk management. This particular chapter which describes the existing literature is considered as the first stage of the three stage research approach.

Chapter four discusses about four cases related to supply chain in a dairy firm. It presents the case background and the various reasons which led to the risks and failure of its supply chain activities. The four dairy cases discussed are melamine crisis in China, Fonterra botulism, Morinaga dried milk poisoning and Snow brand crisis. This particular chapter is the second stage in the three stage research approach.

Chapter five focuses on the analysis of the four cases based on the literature which have been studied in chapter three. A matrix is developed which links the actual supply chain risks from the dairy cases to the perceived supply chain risks from the literature review. The ways in which the firms could ameliorate negative risks by adopting proper supply chain risk management strategies have also been explained. Analysis of the cases and matrix development is the third stage in the three stage research approach. Chapter six provides more analysis and discussion on the four cases. This particular chapter concludes the whole research paper and also addresses possible implications for future research.

Summary: The concept of supply chain and how it is linked to various business scenarios has been discussed in this chapter. An explanation regarding the aim of the study, importance of the study and research questions have been dealt in this chapter. Various concepts and definitions on supply chain, concepts related to risk and risk management have been clearly presented. This fundamental chapter explaining various concepts in supply chain leads us to the next chapter on approaches, which tells us how the study was conducted.

CHAPTER – 2

APPROACH

2.1 OVERVIEW OF THE CHAPTER

This chapter describes and discusses the approach undertaken to do the study. Comprehensive review of the existing literature and case study analysis are the basic methods used to reach the core of the information. Steps in a Comprehensive literature review process, the three stage research approach used for the particular study and how the data management and analysis are carried out to arrive at the findings are pointed out in this particular chapter.

2.2 APPROACH – COMPREHENSIVE REVIEW AND CASE STUDY ANALYSIS

The focus of the study will be on the dairy firm's supply chain risks, its perception and effects on the performance and reputation of the firm and how these can be mitigated and ameliorated if they come to fruition. An analysis of secondary sources in the form of literature on past crises in the dairy industry world-wide are undertaken to see how crises can affect the supply chain of the dairy companies concerned. A comprehensive review of literature was then conducted to develop a conceptual model for handling the supply chain risks and to minimise the negative effects on supply chain performance and reputation of firms should the risks be realised. The findings of these two stages were used to produce a model of risk management in the dairy sector's supply chains.

A comprehensive literature review involves examining the extant literature in depth in a step by step fashion. Comprehensive literature review is an organized, explicit and reproducible method for identifying, evaluating and synthesizing the existing body of completed and recorded work produced by researchers, scholars and practitioners from articles, books and other sources and further include the current research to the existing body of knowledge (Onwuegbuzie and Frels, 2016; Kruse and Warbel). The basic reason for using a comprehensive literature review is because of its transparency, clarity, equality, accessibility and focus. Comprehensive literature review is different from traditional narrative reviews. It differs because the review process is openly reported. The quality of

empirical evidence is assessed from a wide range of disciplines and through detailed search. Citation indexes and cross referencing are used to reach the core of the information.

This particular study involves a comprehensive review which explores journal articles that address risk in supply chain management and how trust, relationship and communication was involved as either as a cause of risk or an intervention to mitigate risk . Special focus is given to dairy firms and their supply chains. Key words such as supply chain, risk, communication, relationships and dairy industry will be used to locate the articles. The search process is detailed in the following sections. Articles identified as relevant that address the key words were analysed thoroughly and in an organized way. A database was constructed and the articles were categorised into three sections (A, B, C) according to the degree (most to least) of relevance to the research question. Notes about each article where then made under the subheading provided under the key words.

2.3 STEPS IN A COMPREHENSIVE LITERATURE REVIEW PROCESS

1. Supply chain journal rankings were used to identify key journals related to the study.
2. Journals for the last several years will be searched in an organized way by using the terms supply chain and risk. Relevant articles will be downloaded.
3. Key words were found out from the downloaded relevant articles. (Note: These key words were not necessarily thus same as those key words pertaining to the research question.)
4. The key words were framed into search strings by using the words OR and AND.
5. Newly constructed search strings were used to find further articles related to the topic.
6. Key authors related to supply chain and risk are identified. It will also be helpful to find the citations relevant to the study.
7. A detailed theme can be obtained from the relevant articles.
8. A framework will be developed for better handling of risks in supply chain and thereby to increase the performance and reputation of the firm.

Case study approach as a method of data collection allows an in depth understanding and exploration of complex situation and behaviour. The limitation of quantitative data on supply chain risk is one of the reasons why a case study analysis is adopted. Case study method assists a researcher to go beyond the quantitative statistical results and understand the behavioural conditions of a situation (Zainal, 2007). Case study approach for data collection helps to explain both the process and outcome of a situation through proper analysis and examination of case studies related to the study field (Tellis, 1997).

2.4 THE THREE STAGE RESEARCH APPROACH

The review of the literature is used to identify main themes related to supply chain risk management, which is used to create a framework for supply chain risk management. The framework is then used to examine and analyse the four cases where supply chain failed in a dairy industry. A matrix is developed to show how the supply chain breakdown occurred in the four dairy firms and how a proper supply chain risk management will help to ameliorate the negative impacts of events that affected the supply chain performance and reputation of the firm.

The study is divided into three different stages as shown in the diagram below:

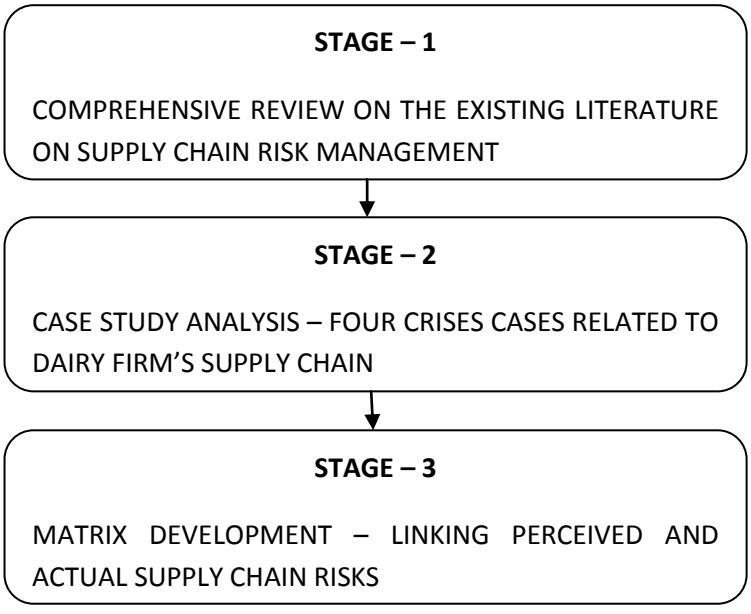


Figure 1: Three Stage Research Approach

Stage one focused on the existing literature on how to manage supply chain risks and its significance, management of responses to crises, importance of relationship management at

the interfaces in the supply chain and how relationship, trust and communication contributes to effective supply chain risk management.

Stage two of this study looks at cases of crises in the dairy industry world-wide such as the melamine crisis in China, the Fonterra botulism scare, Morinaga dried milk poisoning and Snow Brand crisis. Analysis of these in terms of the degree to which they were a supply chain failures and how it impacted on the supply chain will be done. The focus of the case analysis will be on the risks, responses, relationships, trust and on communication.

Stage three is the structural analysis on managing risks in the supply chain of dairy companies and incorporates the risks, responses, relationships and communication findings from the previous two stages. This will involve analysing the perceived and actual risks revealed in the first two stages and looking for relationships between these and key factors such as trust, relationship and communication.

2.5 DATA MANAGEMENT AND ANALYSIS

Comprehensive literature review process used in my thesis includes framing the questions for a review, identifying relevant work or studies, assessing the quality of studies, summarizing the evidence and interpreting the findings. Different themes emerge when the abstract of the article are reviewed. A detailed study of relevant articles will be done to integrate the findings and to create a theme. Secondary themes can be drawn from the primary themes which have been emerged after the review. With the help of these emerged primary and secondary themes a thematic framework can be developed. Emerged theme depends on the quality of the data available.

Summary: The chapter which explains the approaches undertaken to collect the data, different stages of the study along with the initial chapter on definition and different concepts in supply chain and risk management are considered as the fundamental chapters on which the research is developed. This fundamental chapter describing how the study was conducted takes us to the next chapter on comprehensive literature review on supply chain risk management, which describes in detail what the literature says about supply chain risk management.

CHAPTER – 3

RESULTS OF COMPREHENSIVE LITERATURE REVIEW

3.1 OVERVIEW OF THE CHAPTER

A comprehensive review of the existing literature on supply chain and how it is related to risk is carried out in this particular chapter. This particular chapter which describes the existing literature is considered as the first stage of the three stage research approach. The initial sections in the chapter deals with supply chain network and the related risks, supply network stability and the risk management, importance of relationships in the supply chain, how interpersonal relationships in the supply chain helps to minimise the risks and interorganizational communications in a supply chain. Role of trust, relationship and communication for better handling of risks and a matrix on probability and impact of risk is developed and explained later on in the chapter. The chapter concludes by explaining the relationship between performance and risk in a supply chain, a section on supply chain crisis communication and management, the various supply chain risks in the dairy industry, the stages in a risk management and the risk management strategies used by the firms. Finally a conceptual framework for supply chain risk management is developed.

3.2 SUPPLY CHAIN NETWORK AND THE RISK

Risk can be classified according to its impact on a business and the surrounding environment. Risk can be based on the strategy, operations, supply chain, customers, competitiveness, financial, regulatory and legal. The focus of this study will be on the supply chain risk (Meulbrook, 2000) and operations risk (Simons, 1999). Supply chain risk is basically related to the inward flow of a finished product to a particular market or can be even related to the flow of resources for the operations to take place. When such a flow of core resources is affected it can breakdown the manufacturing process. Such risk is termed as operations risk. Supply chain risk can also be termed as input risk. Risk can lead a firm to several losses such as financial, performance, physical, social and time. Loss can be measured on the basis of the damage or danger imposed by the risk. Managers measure loss based on the magnitude of loss (Shapira, 1995).

Supply chain managers while assessing a risk takes into consideration the probability of an event to occur and the likely consequences and damages if such an unlikely event happens. Probability of an unlikely event to occur depends on the degree to which the event is exposed to risk. Facets of risks include exposure to risk, impacts, consequences, losses and magnitude of damages. Risks are not easy to manage once it has occurred. Critical events and impacts can influence the organization, the people and the brand itself (Schwartz and Gibb, 1999). In the modern day businesses, risk is a common phenomenon. But the acceptable level of risk, attitude of the organisation towards risk and risk taking ability differs from firm to firm (Adams, 1995). Some firms are highly risk takers where as some are highly risk averse.

Risks can be external supply chain risks and internal supply chain risks. External risks are those that are outside a firm's control and internal risks are those within a firm's control. External supply chain risks can be a demand risk which is caused by the unpredictable nature of the customer demand, a supply risk which is caused by the interruptions to the flow of final products or raw material flow, an environmental risk due to economic, social and governmental factors. Internal supply chain risks include manufacturing risks due to the disruption of internal operations or processes, business risks caused due to the changes in the key personnel or management stability, mitigation and contingency risks caused by not putting alternative solutions and planning risks due to the inadequate planning and assessment. These risks have eventually started to impact the performance of supply chain partners and also started to affect the reputation of the firm. Supply chain managers are facing a tough time to manage the risks with wide range of activities in a global business (Clemons, 2000). In the current business world, the firms are finding it difficult to deal with supply chain activities because of its complexity and ever changing dynamics (Harland et al., 1999).

Changes in production techniques in the manufacturing sector and complexity in services started to impact the supply chain activities. Uncertainty in customer requirements, lack of supplier involvement, government regulations and political pressure has forced the firms to outsource its activities which further made the operations riskier. Outsourcing the activities helped the specialists to provide part of the whole process (Ford et al., 1998; Lonsdale, 1999). Outsourcing impacted the supply network structure and processes (Knight and

Harland, 2000). Outsourcing paved the way to global markets and this made the supply networks to become globalised.

3.3 RISK MANAGEMENT AND SUPPLY NETWORK STABILITY

Supply risks for a firm can be assessed in terms of supplier availability, competitive demand, make or buy opportunities, risk of storage and product substitution risk (Kraljic, 1983). Supply exposure and supply vulnerability are other terms for risk in supply networks. Firms achieve competitive advantage through proper risk management and there is a connection between inter-organisational relationship and risk management in supply networks. Risk has a relationship with trust, communication and information sharing in a supply chain network (Ring and Van de Ven, 1994). Risk can ruin the relationship between the supply chain partners and can break the level of trust between the partners in a supply chain.

Stability in the supply network will help to reduce the risk associated with it. Supply network stability (Snow & Miles, 1992) can be achieved by developing an appropriate network structure which is suitable to the firm, by maintaining a proper relationship with the existing suppliers, designing a system for careful selection, evaluation and monitoring of sources of supply and developing a proper system of incentives, supplier rewards and risk and benefit sharing practices.

Supply chain risk management focuses on addressing the three dimensions of risk (likelihood of occurrence, consequence of an event and causal pathways) by analysing the source of risk, understanding the forces which drive an event and how these events can create a positive outcome for the firm by minimising the negative impacts. Consequence of an event not always leads to a negative outcome. Firms should understand that risk taking is a potential opportunity by which positive outcomes can be achieved (Blume, 1971). Appropriate decisions can also be taken well in advance to eliminate the negative consequences. Causal pathway relates to the source, nature and causes which generates an event which can be of high risk (Ritchie and Brindley, 2007).

Uncertainty is another important aspect associated with risk. Uncertainty can be a special case which can develop a risk and can lead to a positive or negative outcome (Paulsson, 2004). It occurs when there is insufficient information, lack of knowledge for the decision

maker to identify all the potential outcomes, consequences and likelihood of occurrence (Ritchie and Marshall, 1993; MacCrimmon and Wehrung, 1986). Uncertainty is a situation of total absence of information and inadequate awareness of a potential risk event occurrence irrespective of its outcome being positive or negative (Ritchie and Brindley, 2007).

3.4 IMPORTANCE OF RELATIONSHIPS IN THE SUPPLY CHAIN

Supply chain activities involve dealing with complex multiple relationships between manufacturing firm and its partners (Cooper, Ellram, Gardner and Hanks, 1997). Relationships among these organizations vary from a single to a complex interdependent transaction (Golicic, Foggin and Mentzer, 2003). The complex and competitive environment in which the business is running forces the organizations in a supply chain to get into a long term relationship (Ganesan, 1994; Kalwani and Narayandas, 1995). Firms do benefit from building a closer and interdependent relationship with the suppliers. A committed relationship with the supplier can be a competitive advantage for the manufacturing firm. Misaligned expectations can disconnect the relationship (Mottley, 1998) between the firm and the supplier. Mutual understanding of the expectation is vital for an efficient and effective relationship between the organizations. Clear and concise communication and proper information transaction will help to achieve a right relationship. When firms are in a relationship they have the ability to share resources and knowledge (Dyer and Singh, 1998). Supply chain partner firms who are ready to build on a relationship enjoy access to much needed resources and valuable information.

Relationship depends on the individual needs of the parties and also on the level of intimacy of the organizations. The attributes such as trust and commitment often describes the intimacy or level of closeness of the relationship (Golicic, Foggin and Mentzer, 2003). Commitment (Gundlach, Achrol, and Mentzer, 1995) and trust (Ganesan, 1994; Morgan and Hunt, 1994) are antecedent to relationships. Both of these are considered as components of intimacy in a relationship and can lead to structural bonds (Wilson, 1995) in a firm-supplier relationship. Suppliers who maintain a long term relationship with the manufacturing firm are interested in the final customer needs (Zineldin and Jonsson, 2000). They usually get involved in the future plan of the firm and support for a continuous improvement. Commitment from the supplier adds to the supply chain performance and it is valued much

higher than the natural general interaction (Arnaud and Mills, 2012). Relationships vary on their levels of trust, commitment, expectation, mutual dependence, organizational compatibility, vision, leadership and top management support (Mentzer et al, 2001).

3.5 INTERPERSONAL RELATIONSHIPS IN THE SUPPLY CHAIN TO MINIMISE THE RISK

In a supply chain there can be three types of interpersonal relationships (Mentzer et al, 2001). A direct supply chain relationship is between a firm, a supplier and a final customer, which involves the upstream and downstream flow of information, products and services. An extended supply chain relationship further consists of the supplier's supplier and customer's customer in the supply chain. The ultimate supply chain relationship includes the role of logistics firm, financial provider and market research firm along with the extended supply chain members. It includes all organizations involved in the upstream and downstream flow of activities such as raw materials, finished goods, services information and finance (Mentzer, DeWitt, Keebler, Min, Nix, Smith and Zacharia, 2001).

Relationship between firms usually happens if both the parties are interdependent or has an impact on each other (Berscheid and Pelau, 1983). The change which occurs to one firm causes a change to the other and vice versa. The interpersonal relationship which takes place in a supply chain are impersonal in nature (Silver, 1990), involves a substance or task (Grayson, 2007), can be involuntary (Allan, 1989), usually involves a formal role (Price and Arnould, 1999), exists a sense of obligation (Silver, 1990) with each other. Interpersonal relationship involves an arm's length connection with the partners (Gligor and Autry, 2012). In such a relationship the partners can be replaced by another partner without much economic or social loss (Gligor and Autry, 2012).

The relationship with the partners can be personal, business or both (Social Capital Theory) (Payne, Moore, Griffis and Autry, 2011) combined depending upon the situation. The main aim of the interaction should be a positive outcome (Lian and Laing, 2007; Haytko, 2004). The failure to use personal relationship to a certain extent can leave the suppliers at risk (Gedeon, Fearne, and Poole, 2009) and also can lead to a negative outcome on the firm – supplier relationship (Hutt, Stafford, Walker and Reingen, 2000). The relationship being personal can lead to more loyalty and commitment in the supply chain activities (Adobor, 2006; Johnson and Selnes, 2004). Relationships at the supply chain interface include various

dimensions such as commitment, adaptation, trust, collaboration and communication (Fynes, Voss and De Burca, 2005).

Supply chain partners that are embedded with proper communication and mutual understanding to each other often gain specific benefits (Granovetter, 1985). Such a bonding with the partners (Relational Embeddedness) (Moran, 2005) can lead to an interpersonal relationship with the partner firms. The literature on social capital suggests that partners in a supply chain do behave in a rational manner due to their bonding with each other and depends much on the other partners greater access to knowledge or information which is otherwise unavailable (Granovetter, 1973). Behaviour between the partners can be irrational when a gap arises in the relationship.

3.6 INTERORGANIZATIONAL COMMUNICATION IN A SUPPLY CHAIN

Interorganizational communication between supply chain partners can be explained as the sharing of informal or formal information on a timely and meaningful way (Anderson and Narus, 1990). Communication with the cooperating supplier firms will help to have a better knowledge development (Wallenburg, 2009), proper understanding of complex supply chain issues (Grant, 1996; Kogut and Zander, 1992), retaining a value creating relationships (Christopher, 1992), minimising conflict (Anderson and Weitz, 1992; Claycomb and Frankwick, 2004) and for a superior trust, cooperation and confidence. A number of advantages can be obtained by the firms who have a proper communication with the other supply chain partners.

Quality and regular communication are observed as the foundation for productive supply chain management (Autry and Griffis, 2008). Such a high quality communication with the partners can lead to an increase in transparency (Dyer, 1997), lower transaction cost (Gligor and Autry, 2012), reduce uncertainty between partners (Knobloch and Solomon, 2002), better transformation to change (Schreiner, Kale and Corsten, 2009), greater supply chain performance (Joshi, 2009) and satisfaction (Mohr, Fisher and Nevin, 1996) among the partners. Interorganizational communications aid the firms to attain competitive advantage established on the basis of shared information (Gligor and Autry, 2012).

Communication help in dealing with dispute and matching each other's expectations and perceptions (Morgan and Hunt, 1994). Communication has three features which have to be taken into consideration for a successful interface relationship, the quality of the information, form of information sharing and the joint planning and goal setting (Mohr and Nevin, 1990).

3.7 ROLE OF TRUST, RELATIONSHIP AND COMMUNICATION FOR BETTER HANDLING OF RISKS

Trust can be explained as the belief that the other partner's action would end up in a positive outcome (Fynes, Voss and De Burca, 2005). Supply chain management is built on a foundation of trust and commitment between supply chain partners. High level of trust can lead to a successful relationship (Rankin, 1998). Communication and trust have a positive relationship (Anderson and Narus, 1990) which results in a competitive advantage (Lengnick-Hall, 1996). Communication and increased trust can lead to a greater co-operation, reduces uncertainty, minimised monitoring of contract and willingness to share risks. Mutual trust between the channel partners lead to a superior outcome which cannot be achieved acting independently (Fynes, Voss and De Burca, 2005). As a result of increased trust and co-operation expectation starts growing and eventually develops the relationship which has a positive outcome on the supply chain performance.

Trust depends on the partner's ability to meet their commitment. Trust is not only important at the top level but also at the lower level where employees of different partner firms interact in a supply chain (Arnaud and Mills, 2012). Consistency and predictable behaviour of a partner can develop trust between them (So and Sculli, 2002). A supplier can be considered reliable based on his integrity or honesty towards the business transaction (Sahay, 2003). Trust can also be transferred from one trusted source to another (Milliman and Fugate, 1988). Suppliers willingness to make sacrifices (Ganesan, 1994), ability to take risks and willingness to co-operate to unforeseen situations indicate that the intentions of the suppliers can be believed.

In supply chain, communication can be termed as the link that holds the partners together (Mohr and Nevin, 1990). Communication at the interface allows the partners to convey essential information up and down the chain (Frazier and Summers, 1984), thereby helping

in a proper decision making (Anderson and Weitz, 1992), increasing the commitment and loyalty (Mohr and Nevin, 1990), joint problem solving and better understanding the customers (Lusch, 2011). Communication helps to build, sustain and change relationships so it is both a stabilising and transforming force. For superior supply chain performance focus should be up on interfirm relationships (Sako, 1992), the dynamics of building cooperation (Powell, 1990), the relationship between trust (Vlaar et al, 2007) and contracts (Arnaud and Mills, 2012). Communication is impacted by the manager's ability to get embedded in a proper relationship with the partners (Arnaud and Mills, 2012; Gligor and Autry, 2012). Mutual information sharing between the partners and frequent information updating among the channel partners are a prerequisite for an effective supply chain outcome (Ellram and Cooper, 1990). The firm – supplier relationship can be strengthened and made successful through intense, diverse and frequent communication between the channel partners (Lai, Li and Wang, 2008).

In a supply chain interface, it is usually a department or a person in charge who does the communication on behalf of the firm with the suppliers. Such a personal communication between the employees and supply chain partners can impact towards the success or failure of a supply chain activity (Gligor and Autry, 2012). Communication among the firms in a supply chain can be influenced a lot by the personal relationship of the communicating employees (Gligor and Autry, 2012).

Relationship develops in five stages (Dwyer, Schurr and Oh, 1987) which includes awareness, exploration, expansion, commitment and dissolution. Awareness is the initial perception about the other partner in a supply chain. Exploration is the phase where the partners investigate about each other. Exchange of information and proper communication (Anderson and Narus, 1990) are the main attributes of this phase. Expansion refers to the amount of benefits that can be attained by the process (Fynes, Voss and De Burca, 2005). In the commitment phase, a long lasting continuity takes place among the supply chain partners.

Relationship in a supply chain functions through transfer of information between different firms and at each stage, the collective competence is achieved (Cooren, Kuhn, Cornelissen and Clark, 2011) controlled and balanced. Collective competence can be explained as the

result achieved through communication, interaction and collective action of the partners (Cooren, Taylor and Van Emery, 2006).

3.8 SUPPLY CHAIN PERFORMANCE AND RISK MANAGEMENT

Supply chain performance and risk are interlinked and require adequate managerial decisions and proper implementation of strategies to control the risks and thereby to maximise the performance (Lonsdale and Cox, 1998). Performance in a supply chain can be explained in terms of efficiency and effectiveness. Efficiency depends on the input-output volume. Greater will be the efficiency when there is a greater volume of output for the given volume of resource input (Anthony, 1965). Effectiveness related to the degree to which the planned outcomes are achieved (Ritchie and Brindley, 2007).

Since performance and risk are directly related, a higher risk taking by the firm will lead to a higher performance and potential returns (Knight, 1921). The table below shows the relationship between risk and performance in a supply chain. The outcome varies according to the risk and performance levels and the situation in which the negative event is happening. Different firms have various levels of performance on the basis of how each firm reacts to the risk. In firm 'W' there is a high risk taking and high performance outcome. The presence of a high risk event has reduced the performance in firm 'X'. Low risk situation can lead to high performance (firm 'Y') and at the same time low performance for a firm (Z).

Table 1: Relationship showing Risk and Performance

	PERFORMANCE – HIGH	PERFORMNACE – LOW
RISK – HIGH	W	X
RISK – LOW	Y	Z

Risk has an influence on the various functions of the firm, decisions made, strategy developed and eventually affects the performance (Bettis, 1982). A properly developed strategy could simultaneously reduce risks and increase the performance outcome (Ritchie and Marshall, 1993). Risks in a supply chain is categorised into systematic risk and

unsystematic risk. Systematic risk relates to the risks associated with the environment in which each firm is operating (macro-economic situations, political situations and competitive structure). Such risks cannot be avoided by the firms irrespective of the strategies developed. Unsystematic risks are those risks which can be controlled with the help of proper strategies and its effective implementation.

The key risk sources and drivers can be classified into industry characteristics, organisation's strategy, environment characteristics, supply chain configuration, supply chain members, decision making unit and problem specific variables. These variables not only influence systematic and unsystematic risks but also the potential performance (Ritchie and Marshall, 1993). These sources of risk work individually or in combination to determine the risk and performance outcome of a supply chain network in an organization. Any of the seven sources can generate a risk at any time on a frequent basis there by affecting the smooth functioning of the business (Ritchie and Brindley, 2007). Environment and Industry sources can be systematic risk whereas problem specific variables can be termed as unsystematic risk. There can be number of factors which can lead to a negative consequence in the risk and performance relationship. In organizations the term driver has been used to differentiate the factors likely to have an impact on the risk and performance outcome. For a proper management of risk the firm should focus on these drivers which can cause a negative impact on the performance profile. A risk in a supply chain can be associated with the entire network partners since there is an interrelationship between various network partners. All the partners in the supply chain will be exposed to the risk but the impact to each partner firm depend upon the risk management action or strategy adopted by each of them.

A framework on risk sources and drivers will help the firm to identify, evaluate, prioritise and foreseen them there by to assess the risk and performance consequences for the organization. Degree of uncertainty surrounding the supply chain situation should also be taken into consideration while analysing the risk situation. Every organization faces some adverse event or the other in the course of its business and the best strategy is to improve their preparedness to face such situation (Kovoor-Misra et al, 2000). The risk driver can multiply and have a compounding effect on the potential consequences if it is not managed effectively.

Risk management responses of an organization should include risk insurance, relationship development, strategy development, setting performance standards, proper information sharing, development programme and joint training, developing risk management awareness and skills and frequent joint reviews with the supply chain network partners and the top management. Some of these responses are independent and individualistic in nature (insurance) whereas some of them are co-operative in nature (relationship development and strategic information sharing).

Certain unforeseen events cannot be managed by the organization alone. Other individual organizations and supply chain partners should simultaneously engage in the risk management. Adoption of a particular strategy will enable the organization to ameliorate the negative effects and the impact on the performance. Firms becoming more responsive to the outside environment situation with effective supply chain strategies will help them to reduce the exposure to the systematic risk (Ritchie and Brindley, 2007). An effective market and environment scanning system will help the organization to become more aware and responsive to the risks. Ensuring sound relationship with the network partners helps an organization to ameliorate the potential risks and threats. Risk mitigation strategies can be a proper information sharing, increasing supply chain agility, trust building, collaborative relationships with supply chain partners (Faisal et al, 2006). Strategies focusing on the buyer-seller relationship will also help to reduce the risk (Chen and Paulraj, 2004). Along with the buyer-seller relationship strategies, supply chain integration strategies also play a vital role in risk management (Cousins and Menguc, 2006). Stakeholders of an organization comprises of a diverse group of individuals with various expectations on the performance and risk of the firm. But in reality it is often the risk management decision makers who assess and evaluate the risk sources and drivers and establish a risk management solution.

3.9 PROBABILITY – IMPACT RISK MATRIX

The probability and level of impact of a risk are assessed and prioritized to adopt a suitable strategy or action to minimise the risk factor (Hallikas et al, 2004). A probability – impact risk matrix can be used to assess and prioritize the risk event. The probability of risk and impact levels varies from firm to firm in a supply chain network. The risk consequence should be analysed from the viewpoint of each individual firm. Just because the risk probability and

impact is high for a particular firm does not mean that it should be high for all the other firms in the supply chain network. A risk factor or event which is favourable to one firm in the supply chain network may not necessary have a positive impact on another firm in the same supply chain network (Hallikas et al, 2004).

The Probability – Impact risk matrix consist of impact assessment scale on the horizontal axis and probability assessment scale on the vertical axis. Impact assessment scale consist of

- Low Impact: Risk impact is not much significant to the firm.
- Medium Impact: Risk causes short term difficulties and losses.
- High Impact: Risk causes long term difficulties and loss is also significant. Business has to be discontinued if it is a serious risk.

Probability assessment scale consist of

- Low Probability: Rare or indirect evidence of factors or events.
- Medium Probability: Moderate and direct confirmation of factors or events that can cause a risk.
- High Probability: Strong direct evidence of events that can cause a risk. Such events usually reoccur frequently.

Table 2: Probability – Impact Risk Matrix

HIGH PROBABILITY			
MEDIUM PROBABILITY			
LOW PROBABILITY			
	LOW IMPACT	**MEDIUM IMPACT**	**HIGH IMPACT**

The risk matrix provides overall information of the various risks in the supply chain network. It helps to bring to limelight the most important risks that require an immediate action. The matrix can also be used as a method to transfer vital risk information to the other partners in the supply chain network.

Supply chain risk can be assessed with the help of several tools and frameworks. The risk assessment tools and framework is primarily based on two main paradigms, probabilistic choice and risk analysis based on impacts (Miranda and Proenca, 1997). In a probabilistic choice the decision is based on the risk situation and is evaluated based on the final solutions average behaviour (Manuj & Mentzer, 2008). Risk analysis paradigm helps to minimise the regret caused by the risk. Regret in risk can be explained as the cost associated with a right decision that could have been adopted if the manager knew what would have happen at an earlier stage (Manuj & Mentzer, 2008). The probabilistic choice paradigm is suitable when an extreme solution is needed for the firm and risk analysis based on impacts approach favours a balanced and cautious situation. Depending on the type of risk situation a combination of probabilistic choice and risk analysis approach can also be used by the firms.

3.10 SUPPLY CHAIN CRISIS MANAGEMENT

A crisis in a supply chain can be termed as an abrupt, uncertain, unexpected and major event that can pose a potentially negative result for an organisation and its activities. It can affect its reputation, performance, products, services, employees and financial aspects (Koster & Politis-Norton, 2004). Crisis can be further explained as negative "events occurring when there is forceful takeover of an existing functionality, activities or mechanisms in an organization, a need for a major redistribution in the resources or when an organisation recognises the need for both the events to happen" (Korac-Kakabadse, Kouzmin & Kakabadse, 2002). When there is a failure in a supply chain, a crisis is most likely to occur that has the potential to damage a firm's reputation. It can happen the other way round as well, an organizational crisis can decrease the performance of the supply chain and thereby causing a threat to the firm's image. Crisis communication and planning plays an important role in such a situation to manage the risk associated with it.

Any organization is vulnerable to endless number of crises. Crises could be prevented or minimised if the concerned managers are prepared to face a crisis at any given point. Supply chain managers should be equipped to anticipate, respond and learn from the previous crisis events (Pearson & Mitroff, 1993). Crisis can exist between natural disasters and human induced. Firms have very less control over the crisis occurred out of natural disasters. They can only be prepared to face such uncertain situations. Human induced crises generally have more negative responses from the public. Such crises can destroy the performance of an organization and also the reputation of a firm. Human induced crises can be prevented or minimised by proper crisis management and planning (Pearson & Mitroff, 1993).

Crisis in the modern day business usually have large impacts, can affect the smooth operation of the functions and activities, affect the reputation of the organization and its performance, often connected with extreme uncertainty and involves critical communication issues (Boin & Lagadec, 2000). Crisis is very complex in nature, interconnected and increasing in the day to day business activities. The complex nature of the crisis along with small disruptions in the organisation can lead to a rapid escalation of the situation (Perrow, 1999). One of the main reasons which can lead to crisis in a supply chain is the firm's inability to influence and control certain unexpected situations and the flow of events which escalates with it (Koster & Politis-Norton, 2004). An organizations reputation is considered as the most important asset and it is widely recognised as a valued resource (Winkleman, 1999). Uncertain events or crises can damage the organizations reputation by disrupting the operations. In such a situation, proper communication during a crisis develops a prescriptive system for matching crisis response strategies to the crisis situation (Coombs & Holladay, 2002).

Managing the crisis with proper response, communication and planning helps to minimise and repair the lost reputational image. Communicative response from the supply chain managers helps to protect the reputation of an organisation when faced with a crisis challenge (Coombs & Holladay, 2002). To protect the organizational reputation the supply chain managers should adopt a crisis response based on the uncertain situation (Benson, 1988). Each crisis situation should be dealt with different crisis response strategies (Benoit, 1995). There is a link between crisis type and the response strategies selected (Hearit, 1996).

In the event of a crisis the concerned crisis manager along with the supply chain manager should identify the crisis type and do a proper analysis before selecting a crisis response strategy. The crisis response strategy adopted by the firm should be able to accommodate the amount of reputational damage caused by the crisis. The success of crisis handling depends on the organisations ability to control the uncertain situation. In fact, there is a high correlation between a crisis situation, how it is controlled and with organisations performance and reputation (Coombs and Schmidt, 2000).

The main purpose of crisis management is to have a certain preplanning, structured strategies and communication as precautionary measures to ensure that the crisis don't cause too much reputational damage. Crisis management helps to control and limit the impacts of negative events as much as possible. One of the greatest threats a crisis can cause is the impact it can have on the firm's image and reputation (Koster & Politis-Norton, 2004).

A proper crisis management focuses and prepares a firm not only on the crisis event handling but also on the outcome management (Koster & Politis-Norton, 2004). Crisis planning should give importance to implementation of strategies, ensuring that right amount of guidance and actions have been taken. Proper decision making at the right time is the most important aspect of a successful crisis management.

Certain rules which can be followed by organisations in the event of a crisis: Always develop a crisis management team, get to the core of the problem and define it, focus on the issue in detail, gather all possible information, always assume for the extreme situation, be ready for short term sacrifices to get things back on track, communication and strategies should be based on the analysis of the situation, plan for the best possible outcome, trust in your decision and strategies and finally be patient for the situation to change.

3.11 CRISIS COMMUNICATION IN A SUPPLY CHAIN

Crisis communication helps an organization to protect its reputation with the external stakeholders during a crisis situation (Coombs, 2007; Coombs, 2004). Crisis can be a threat to the firm's reputation and has an influence on how external stakeholders interact with the firm (Barton, 2001). Crisis communication is often used by the firms to repair their

reputation and to prevent the firm from further damage (Coombs and Holladay, 2005). Crisis managers need to understand and adopt a situational crisis communication theory (SCCT) in order to protect the image of the firm and for a proper management of the crisis situation (Coombs, 2007). SCCT helps the crisis managers to have a deeper understanding with respect to the causes of the crisis situation, how external stakeholders see the crisis situation, their reaction to it and how the outside world respond to the strategies implemented to deal with the crisis (Sturges, 1994; Coombs, 2010).

Situational crisis communication theory (SCCT) is often used by the crisis managers since an evidence based communication is vital for deciding a response strategy, decision making, proper crisis management and to maximise the firm's reputation (Coombs, 2007). When a firm is hit with a crisis, the external stakeholders who are associated with the firm often search for exact cause of the negative events (attribution theory) (Weiner, 2006). The reaction to the negative event can be based on various emotions such as sympathy, anger or negative word of mouth. SCCT is built on the foundation of this attribution theory (Coombs, 2007). SCCT helps the crisis manager to analyse and understand the crisis situation in a well organized way and thereby helping him to implement the crisis response strategy to protect the reputational image (Coombs & Holladay, 2002; Coombs, 1995). The theory focuses on assessing the level of damage caused to the reputation of a firm. The factors which shape the crisis threat are the initial actions taken, history of the crisis event and earlier reputational threats to the firm (Coombs, 2004).

SCCT by Timothy Coombs helps to identify the crisis outcome and behavioural intentions and based on it a crisis communication is developed on a strategic level (Coombs, 2007). According to Coombs, the success of a crisis response depends on how well the firm manages the pre-crisis and the post-crisis situation (Coombs, 2004). The pre-crisis phase deals with the prevention and preparation where as post-crisis phase deals with learning from mistakes and success (Coombs, 2007).

Crisis communication should be based on the crisis type, history of the crisis event and also based on the reaction of the external stakeholders to the crisis event (Coombs, 2007). This particular reaction of the stakeholders should be anticipated by the crisis managers before adopting a crisis response strategy (Marcus and Goodman, 1991). Proper understanding of

the perception of stakeholders will also help to assess the degree of reputational threat that will be incurred by the crisis situation (Marcus and Goodman, 1991; Coombs, 2004). Communication based on the assessment of perceptions and reaction will help to manage the crisis situation in a better way by protecting the firm's reputational assets (Coombs, 2007).

3.12 CLASSIFICATION OF SUPPLY CHAIN RISKS

Supply chain risks in a dairy industry can be classified into various ways according to its different viewpoints. It can be broadly classified into three main categories which can be further sub divided into five other categories. Supply chain risk in a dairy industry is related to the unfavourable events which affect the proper functioning of the supply chain to deliver raw materials to the firm or finished goods to the customers within the estimated time and costs (Christopher and Peck, 2004). The decisions relating to supply chain risk in a firm can be categorised into operational, tactical and strategic (Ritchie and Brindley, 2007). Supply chain risks are often operational disturbance, tactical disruption and strategic uncertainty (Paulsson, 2004). However, Kleindorfer and Wassenhove (2003) categorised supply chain risks into supply co-ordination risks and supply disruption risks. In reality a firm usually categorises strategic uncertainty as a combination of operational disturbance and tactical disruption (Mintzberg and Waters, 1985).

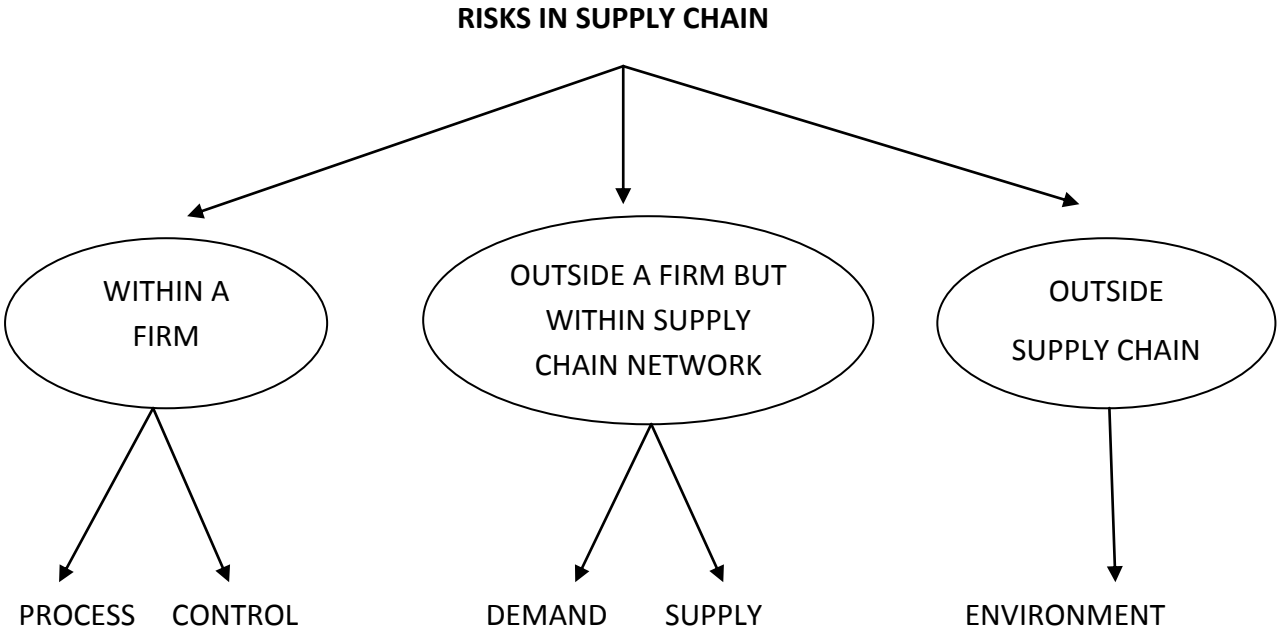


Figure 2: Risks in Supply Chain

The 3 main categories and their sub categories of risks are as follows:

- Within a firm risks
- Outside a firm but within a supply chain network risks
- Outside a supply chain network risk

Within a firm risks can be termed as operational risks where as outside a firm but within a supply chain network risks can also be termed as demand and supply risks. Outside a supply chain network risk is also known as external environmental risks. Within a firm risks includes processes and controls. Such a risk is also known as operation risk. It is related to the disturbance to the firm's internal ability to produce goods and services in the specified time frame. It also takes into account the quality of the product and profitability. Processes comprises of value added activities within a firm, product quality, safety regulations and inventories. Various processes of an organization are dependent on internal assets, infrastructure, transportation, network and communication. Disruption to any of these activities can be termed as process risks. Within a firm or operational risk also incorporates risks which arise due to the lack or misapplication of control factors. In the supply chain network, control usually consists of rules, procedures, expectations, assumptions and speculation related to future supply, raw materials, transportation and quality of finished product.

Outside a firm but within a supply chain network includes demand and supply risks. A disturbance to the flow of raw materials, finished products or information in the supply chain network leads to a demand and supply risk. Potential risk to the downstream activities of a firm is known as demand risk and disturbance to the upstream activities of a firm is termed as supply risks (Christopher and Peck, 2004). Demand risk can arise due to lack of forecast, variability in demand and lack of proper information on competitor. Demand risk is related to the threat to the outbound flows which can affect the customers in placing the order or firms lack of knowledge regarding the exact demand for the product in the market. Supply risk is associated with the negative events which can affect the inbound supply of raw materials which can delay the production and also the firm's ability to meet the customer demand at the appropriate time. Supply risk can be due to poor inbound product quality, lack of supplier exploitation when needed and variability in transit time.

Outside a supply chain network often includes the external environment. The upstream and downstream activities in a supply chain can be impacted directly by the events which happen in the external environment. Such events can affect the whole supply chain or any particular interface in the supply chain. The impact may be due to an economic, political, social, cultural, technological or natural event in the environment. The negative events which arise in the external environment can be predicted to certain extent but the impact of these events on the supply chain is difficult to assess (Christopher and Peck, 2004). Risk factor increases when a firm fails to identify the future disturbance. Lack of communication or information transfer also leads to negative impact in such situations. When information is not shared in an appropriate way it can lead to supply chain vulnerability.

Apart from the above mentioned risks there are other risks such as security, risks due to currency, transit time variability, safety, forecasts, oil, price fluctuations and cultural. Security risk is linked to the risk to the information system, freight breaches, data or vital information getting stolen, threat to human resources and crime.

3.13 RISK MANAGEMENT STAGES

Stages in risk management assist the supply chain managers to identify, assess, manage and control risk in a proper way (Harland, Brenchley and Walker, 2003). Stages include:

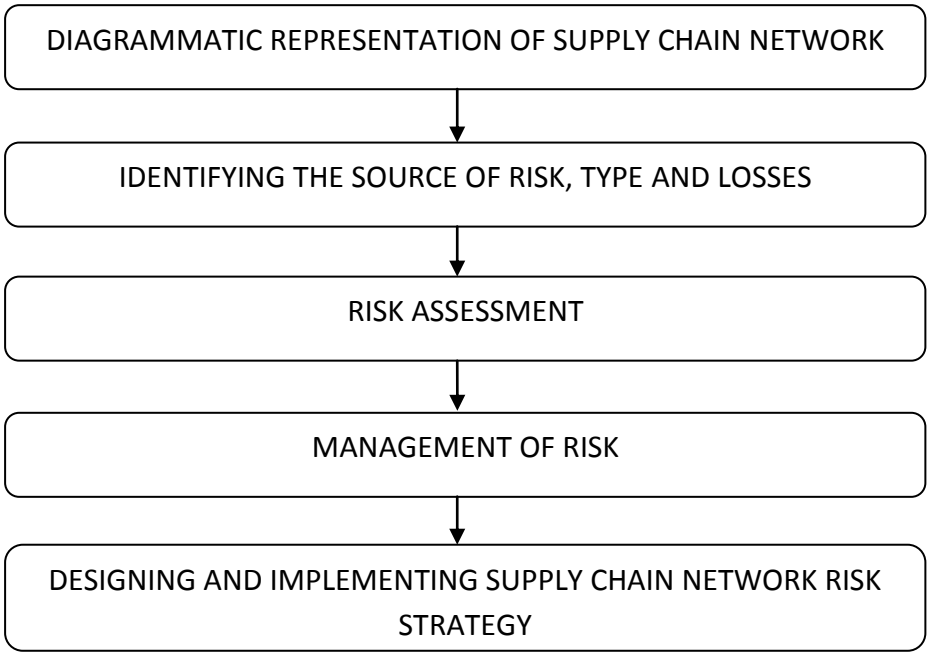


Figure 3: Risk Management Stages

Stage: 1 – Diagrammatic representation of supply chain network: Based on the problem and the specific exposure to risk, the supply chain network is diagrammatically represented to have a clear understanding and for a deeper knowledge about the ownership, key measures which are in place and also for the specific roles and responsibilities (Harland, 1997).

Stage: 2 – Identifying the source of risk, type and losses: Information related to the risk source, type of risk and the exact losses are identified in this particular stage. Those specific risks which are connected with the current problem should be identified and also the potential loss which such a risk can cause should also be taken into consideration.

Stage: 3 – Risk assessment: Risk which has emerged is assessed for the likelihood of occurrence, likely triggers, losses it will bring and its exposure to the day to day business activities (Harland, Brenchley and Walker, 2003). A careful analysis of the risk, its origin and nature is carried out for a proper management.

Stage: 4 – Management of risk: The existing risk is managed by taking into account the assessment information and by developing risk strategies and decisions (Harland, Brenchley and Walker, 2003). Risk position will be developed based on the particular risk problem and on the actors which has led to the problem. Risk averse or cautious scenarios will be used by firms to manage the risk according to its intensity

Stage: 5 – Designing and Implementing supply chain network risk strategy: Strategies are developed to realign the risk, to know more about its origin and factors which led to such a situation and to understand the likely damages it can cause. Such risk strategies will give rise to a remodelled supply chain network and the relationship between the partners is also affected which in turn redesign the roles and responsibilities.

3.14 RISK MANAGEMENT STRATEGIES

Risk management in a systematic way allows the dairy firm to identify, quantify, control and monitor risk in an appropriate way (Schaper, Lassen & Theuvsen, 2010). Risk management strategies will help a farmer to identify the risks in a supply chain and to respond to those risks in the most suitable way. Managers must consider two options when they try to develop a supply chain risk management strategy. Firstly, there should be a proper understanding of the supply chain risks in the organization and secondly the specific

department should find approaches for risk mitigation and try to adapt to the new situation. Strategies generally used to manage risk include risk avoidance, risk reduction, risk transfer, risk taking, risk sharing and analysis of individual risks (Hallikas et al, 2004).

In a supply chain network, risk avoidance strategy often requires immediate stopping of certain management activities. It helps to reduce the exposure to internal and external risks. In certain situations the dairy firm has to stop the production to avoid certain risks associated with the dairy production (Schaper, Lassen & Theuvsen, 2010). It can be a loss to the dairy firm but it helps the firm from a major risk. Risks can be reduced through proper identification, assessment and also by developing network risk strategy. In a high impact situation the risk has to be taken care by the individual firms. The risk reduction strategy helps a firm from potential losses or damages. Such a risk strategy reduces the risk incidents and also diversifies the firm activities to improve the exposure to supply chain risks. In a risk transfer strategy, the risk incidents are transferred to other partners in the supply chain. Dairy farmers and processing firms can transfer the risks to insurance companies by availing insurances. Risk can be also transferred to buyers by entering into a price guarantee for the dairy products for a long term (Schaper, Lassen & Theuvsen, 2010). When a firm fails to identify the potential risk or incidents and when a particular risk strategy cannot be implemented in a particular situation, risk acceptance strategy is adopted by the firms.

There can be four types of strategies for a supply chain when there are supply and demand uncertainties (Lee, 2002). Efficient strategy – High cost efficiency when there is low supply and demand uncertainty, Responsive strategy – Focus on flexibility and responsive to high demand uncertainty and low supply uncertainty, Risk hedging strategy – Focus on pooling and sharing risks when there is high supply uncertainty and low demand uncertainty and Agile supply chain strategy – Focus on responsiveness and hedging risks when there is high demand and supply uncertainty.

3.15 CONCEPTUAL FRAMEWORK FOR SUPPLY CHAIN RISK MANAGEMENT

Increase in the customer demand, competitive pressure and profitability have increased the risks in the supply chain network (Manuj & Mentzer, 2008). Firms are aware of the need for a proper risk management and have started to restructure their operations. To minimise the risks in a supply chain it requires a highly coordinated flows of communication, goods,

services and relationship between the network partners (Mentzer, Stank & Esper, 2008). Dairy firms to maximise the profits procure raw milk and other raw materials from sources which are low in procurement cost (AlHashim, 1980). The quality of such procurement cannot be guaranteed thereby increasing the risk in the whole supply chain network. Risk related to finance, economics, international business, insurance and strategic management are widely studied and there is plenty of literature on the topic. But the literature on supply chain risk is comparatively less and there is a lack of conceptual framework to provide a clear understanding and guidance for a proper supply chain risk management.

A conceptual framework for supply chain risk management (Manuj & Mentzer, 2008) is discussed based on various concepts, insights, different frameworks and knowledge from different disciplines such as operations management, logistics, strategy and international business management.

CONCEPTUAL FRAMEWORK

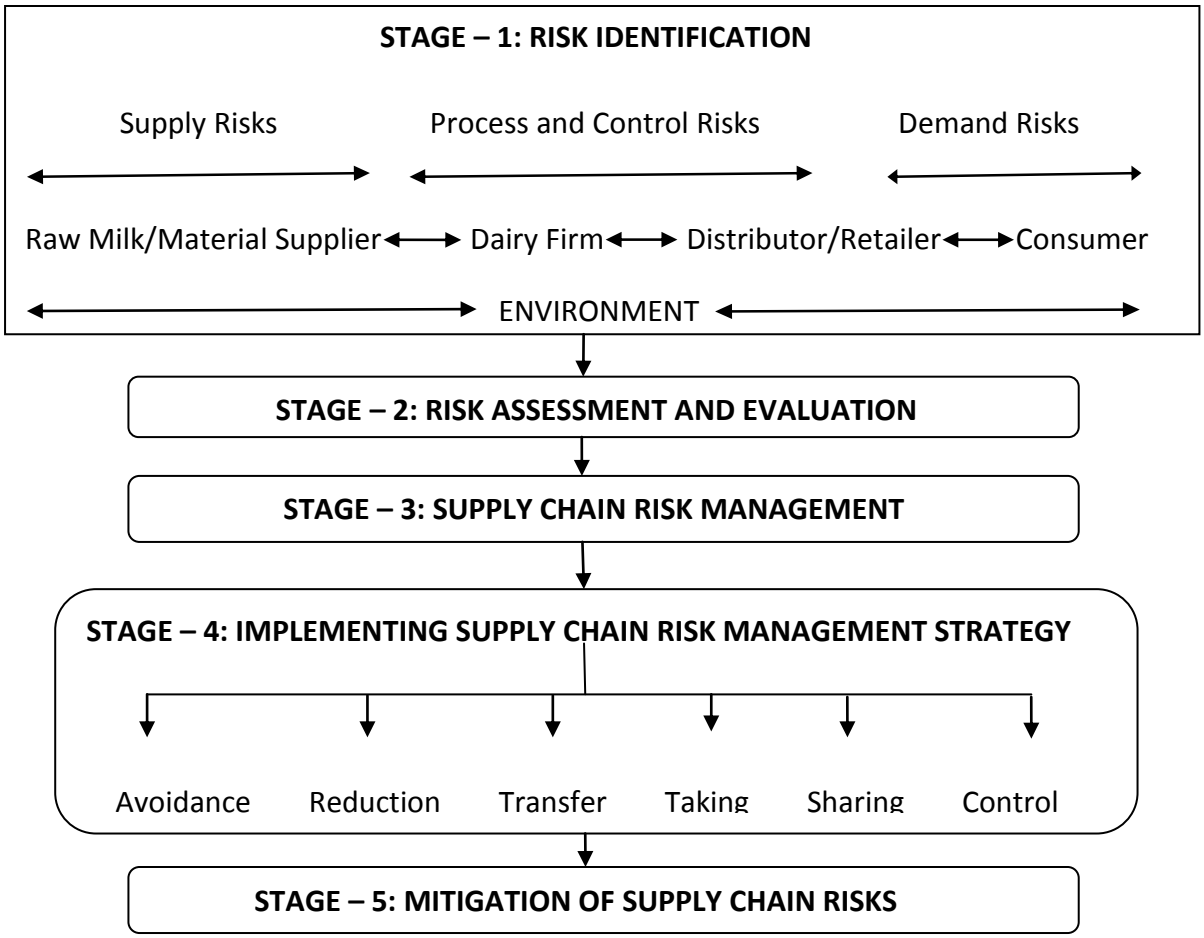


Figure 4: Conceptual Framework for Supply Chain Risk Management

The framework comprises of five steps (Manuj & Mentzer, 2008). The explanation of each stage has already been provided in the earlier sections.

- STAGE – 1: Risk Identification
- STAGE – 2: Risk Assessment and Evaluation
- STAGE – 3: Supply Chain Risk Management
- STAGE – 4: Implementing Supply Chain Risk Management Strategy
- STAGE – 5: Mitigation of Supply Chain Risks

Firms can manage the supply chain risks by following a path from identification of risk to proper assessment and management to implementation of strategies (Manuj & Mentzer, 2008). Risk identification should happen at each and every level of the supply chain network. It should be undertaken in the contexts of supply, demand, process and operations, resources and in the context of outside environment in which the firm is doing business. As a whole risk identification should be based on the various supply chain partners and how the external environment is interacting with the focal firm (Manuj & Mentzer, 2008).

Uncertainty over competitive advantage (Kogut, 1985) and logistics operations further add to the risk in the supply chain. It can be a strategic, tactical and operational level uncertainty in a logistics operation (Schmidt and Wilhelm, 2000). Performance of the supply chain also depends on the lead time uncertainty and supplier reliability (Schmidt and Wilhelm, 2000). Even with the advent of IT, physical transport of goods can be affected by lead time uncertainty (Speh and Wagenheim, 1978).

Supply chain risk sources can be categorised into atomistic or holistic (Svensson, 2000). When a part of the supply chain is only required to assess the risk it is termed as atomistic sources of risk. It is generally non-complex, low in value and materials and components are widely available. Holistic approach denotes that in order for a risk assessment, an overall analysis of the supply chain is required and is usually very complex, high-value and components are unique or rare. It is vital to have an in depth knowledge about the source of risk for a proper management of supply chain risk.

Risks in a supply chain can be classified as quantitative and qualitative (Manuj & Mentzer, 2008). Risks such as shortage of raw materials and other components, stock outs, customer discounts, overstocking and obsolescence can be classified as quantitative risks. Qualitative risks include supplier reliability, lack of accuracy and quality of materials and components procured from supply chain partners. These two risk classifications create a need for atomistic or holistic assessment of supply chain (Manuj & Mentzer, 2008).

Supply risk is associated with the procurement of raw materials which can cause failure from supplier to deliver on time which in turn affect the production system. It results in the inability of the dairy firms to meet customer demand within the anticipated time and cost (Zsidisin et al, 2004). Supply risk includes the risk involved in the movement of materials from the supplier's supplier to the dairy firm, reliability of suppliers, inbound product quality, transit time variability, security issues, price escalation (Manuj & Mentzer, 2008). When compared to single sourcing, multiple sourcing of raw material weakens the relationship between the suppliers and the dairy firm (Berger, Gerstenfeld & Zeng, 2004). Single sourcing is comparatively better in the case of quality of the raw material as well.

Operations risks are those events which can affect the smooth operation of the firm's ability to produce goods and services, quality of production, timeliness of production and profitability of the firm. The source of an operational risk is usually seen from within the firm. It results in breakdown of core functions, inadequate processing and manufacturing capability (Simons, 1999). Demand risk is associated with the outward flow of finished goods. Sources of demand risk can be variations in the production with that of customer's actual demand, risks connected with the movement of products from the dairy firm to the final customer, delay in introducing new products to the markets and variations in demand (Fisher, 1997; Manuj & Mentzer, 2008).

In a supply chain, certain risks can be vulnerable and very critical for the successful operation of the activities in the network. These risks have to be assessed well and more attention has to be given. Risk assessment tools can be broadly categorised into three. They are decision analysis, case study and perception based. These tools depend on various degree of probability which is attached to each risk event. Decision analysis approach is

often used to generate a solution set in a high risk event (Berger, Gerstenfeld & Zeng, 2004). Events with high risk have an uncertain outcome and extreme consequences.

Case study approach of risk assessment in a supply chain network was developed by Harland, Brenchley and Walker in 2003. The approach consists of mapping the supply chain network in a sequence, identifying the risk and its location, risk assessment, managing risk and implementing a risk strategy. Hauser (2003) modified the existing case study method and incorporated a framework which included the possibility to analyse, prioritize and measure the impact of risk on an organization. The framework is also used to identify critical business events, the risks associated with it and to know the complexity of the risk. The framework provided by Hauser helps the managers to develop a proposition which can be aligned with firm's goal.

Perception based risk assessment tool developed by Simons (1999) helps to determine whether a firm is in a safety, caution or danger zone with regards to its risk event. The tool helps to determine the firm's likelihood of being surprised by errors or breakdowns. The perception based risk assessment is established on the basis of three types of internal pressures, such as growth, culture and information management. Firms should separate the supply chain risks on the basis of its severity and probability (Hallikas et al 2004). Severity risks can be grouped as insignificant, minor, serious and catastrophic where as probability can be termed as very unlikely, improbable, probable and very probable. Perception based approach is useful when the managers have to depend on business intelligence and intuitive thinking to deal with the risk (Manuj & Mentzer, 2008).

In a supply chain risk management, the initial stages of identifying and assessing the probabilities and consequences of risks are followed by selecting and implementing an appropriate risk management strategy which can reduce the probability of losses and consequences associated with the negative events (Norrman and Jansson, 2004). The risk management strategy which is selected should be in match with the supply chain strategy and the corporate strategy. The supply chain risk management strategies can be categorised into avoidance, reduction, transfer, taking, sharing and control (Miller, 1992). These different strategies are closely linked to each other and the application of one strategy can lead to the usage of another strategy. In order for a successful implementation of strategy it

requires superior execution skills, commitment, discipline, leadership, creativity and reducing the complexity in the supply chain network (Freedman, 2003). Providing adequate amount of flexibility in the supply chain network will help the firm to manage the high level of environmental and operational uncertainty (Kogut and Kulatilaka, 1994; Upton, 1994).

Communication and information transfer is vital for a proper implementation of the risk strategy and for an effective management of supply chain (Bowersox and Daugherty, 1995). The whole process of supply chain risk management is an information intensive process and fully depended on the uninterrupted and genuine communication between the network partners. Risk mitigation plan provide a firm with mature decisions to face unexpected events and the potential losses (Manuj & Mentzer, 2008). The success of a risk mitigation plan depends on how well a firm identify the possible losses that may arise from an unexpected event.

Summary: Supply chain and the risk associated with it have been clearly discussed in this chapter. The role of trust, relationship and communication as the main parameters for better handling of risks and a conceptual framework for a proper supply chain risk management, which can be adopted by any dairy firm are explained here. It shapes the first stage of the three stage research approach. This particular chapter paves the way for the second stage of research which describes the four cases related to dairy supply chain.

CHAPTER - 4

RESULTS OF DAIRY CRISIS CASES

4.1 OVERVIEW OF THE CHAPTER

The chapter explains four dairy cases involving supply chain crises. The risks involved in the supply chain of each firm have been described in detail. This particular chapter is the second stage in the three stage research approach. The four dairy cases explained here are melamine crisis in China, Fonterra botulism, Morinaga dried milk poisoning and Snow brand crisis.

4.2 MELAMINE CRISIS IN CHINA

4.2.1 OVERVIEW OF THE CASE

An introduction about the dairy industry in China along with a brief explanation of melamine and the factors which led to the dairy contamination is provided. Melamine adulteration crisis and a timeline is shown and explained in detail in the next section. It is followed by the impacts of the crisis on the supply chain, causes of the dairy crisis, measures taken for the crisis management and concludes with the policy improvements and recommendations.

4.2.2 INTRODUCTION

Dairy products are an important component of human diet. Milk and its products are vulnerable to adulteration and bacterial contamination. The dairy industry is one of the main sources of income for the Chinese economy. The dairy sector found innovative techniques to gather small and medium scale farmers and made them a part of the large dairy supply chain. In the early 2000, the dairy industry in China grew by four times when compared to the previous years. In China, the safety of dairy products has become a public concern in the aftermath of a serious outbreak of Melamine poisoning of infants in 2008 (Qian, Guo, Guo & Wu, 2011.

An organic base chemical known as Melamine with high Nitrogen content was found in the infant formula sold by majority of the dairy companies. Melamine is an artificial product used to increase the protein content in the infant formula. Melamine is a trimer of

cyanamide from industrial uses which is combined with formaldehyde to produce melamine resin (Yang et al, 2009). It is a durable thermosetting plastic used as a polymeric cleaning product and is also a major component of pigment yellow 150, fertilizers and derivatives of arsenical drugs for the treatment of African sleeping sickness (Barrett & Gilbert, 2006; Yang et al, 2009). Raw milk was adulterated by using artificial ingredients such as melamine, vegetable protein, urea and other powders.

Past researches reveal some contaminants in the dairy products such as biomedical and chemical factors. Dairy contaminants were caused by accidents, carelessness and overzealous use of antibiotics (Khaniki, 2007). Milk was even contaminated on pooling and pasteurization stages (Prejit-Nanu and Latha, 2007), poor hygiene practice and due to health condition of animals (Ghazi et al, 2010).

There were socio-economic factors responsible for melamine contamination. Research reveals that it is difficult for dairy firms, dairy collection centres and dairy farmers to perform quality control at each stage of milk production and processing (Takarabe and Osamu, 2009). The main reason for contamination and poor quality was due to lack of supervision, long supply chain and firm's aim to make high profit. Excessive price competition also led to the poor quality of dairy products. Since 2007 the price of imported milk powder was increasing at a rapid pace which urged the domestic milk manufacturers to supply raw milk at a lower price. Due to the increase in demand the low quality of raw milk was overlooked (Xiaojing, 2011). Problems such as law and regulation system, government supervision mechanism, detection capability and quality standard system were also responsible for melamine crisis (Chen, 2010).

Dairy firms had to procure milk from diverse areas such as small and medium scale farmers and different collection centres. Intense competition, entering new markets and lack of proper quality measures urged the firms to adulterate and water down the quality of milk. Firm's much emphasis on the supply chain and reliance on wide network of millions of dairy farmers across China and raw milk supply stations has increased the vulnerability towards milk adulteration (Gale & Hu, 2009). Some of these small scale farmers are located in the rural areas of China and dairy firms had to depend on logistics company for on time delivery of raw milk. The dairy firms had the latest technology, milk processing units and an up to

date safety management at work place but too much reliance on dairy farmers, milk traders and logistics company to reduce the raw material costs has provided the firms with flexibility to sacrifice on quality measures and to deal with improper monitoring and standardization of products (Lohmar et al, 2009). These aspects made the firms more vulnerable and lead to the adulteration crisis.

Market structure, inappropriate food safety regulations, price fluctuations and intense competition for low cost raw milk forced the firms to practise the unethical way to adulterate the milk. Dealing with number of small and medium scale farmers, milk cooperatives and independent milk supply stations in the rural areas made traceability, safety and assurance of raw milk quality at threat.

4.2.3 MELAMINE ADULTERATION CRISIS

Chinese Melamine started in the year 1958 and it increased to 22.8% during the years 1980 – 1987. By the year 2000, China saw a growth in both production of dairy products and also in its consumption. At present China is the world's largest exporter of Melamine. Protein powders such as Melamine were used to increase the protein content of the raw milk at a less cost while it is tested for its quality. Dairy farmers use such adulteration process to water down the raw milk and to have a positive result in its protein and vitamin contents. The concept that melamine has no toxic effects on humans encouraged adulterers including farmers and milk collectors to add melamine as a fake protein (Gale & Hu, 2009). Rural milk traders and farmers added different quantity of melamine, protein powder, different antibiotics, vitamin C, fat and chemicals such as sulphuric acid and hydrogen peroxide to increase the protein content and the richness of the milk artificially. The practise of adding protein and melamine to animal feed to have a high nitrogen level was not practised in China until the milk adulteration incident (Barboza, 2007).

Standard tests such as the Kjeldahl and the Duma's tests estimate protein levels by measuring the nitrogen content (Snyder, 2007). Melamine can be used to mislead such tests. Milk collectors and dairy farmers can earn more benefit by diluting the milk at the same time get the desired result of high protein content by adding melamine.

Melamine incident occurred in China in the year 2008 which brought many negative effects in the health of infants and has instigated social unrest in China (China Daily, 2010). The contaminated dairy products crisis led to the death of 6 infants and close to 300,000 babies became sick because of kidney problems caused by melamine (China Daily, 2010; Qian, Guo, Guo & Wu, 2011). The Sanlu Group located in Shijiazhuang is one of China's largest dairy manufacturers was involved in the scandal along with other major players like China Mengniu Dairy Co, Inner Mongolia Yili Industrial Group and Shanghai Guangming Dairy and Food Co (Qian, Guo, Guo & Wu, 2011). The crisis lead to a series of negative effects on China's dairy industry and also ruined number of domestic dairy farms and businesses in the country.

Table 3: Details of the incident as it occurred in Sanlu Group

December, 2007	Sanlu received complaints from consumers about its milk powder.
May, 2008	The complaint was reported to the top management including the president and vice-president.
May, 2008	An investigative team was formed by Sanlu and presence of excessive nitrogen in its infant formula was found, which raised a doubt of melamine contamination.
June, 2008	Milk products were again tested at the official testing centres. Products which were assumed to be contaminated were produced in October, 2007. All milk products which were produced till December, 2007 were recalled from the market.
July, 2008	Testing bureau confirmed that melamine was contained in 15 batches of milk products.
July, 2008	Investigation on the infant kidney stone has started at the Gansu health administration.
August, 2008	Sanlu has confirmed that certain batches of their dairy products have been contaminated and an official recall has been established.

	They also agreed to compensate the victims.
September, 2008	700 tons of melamine contaminated milk powder had been recalled. More than 6200 children were reported affected by melamine contaminated milk. 59 Infants developed kidney stone and 3 died after consuming Sanlu's milk powder.
September, 2008	The central government ordered Sanlu to stop production and sale of its milk powder. Other major dairy firms such as Mengniu and Yili also recalled their infant formula.
September, 2008	State council set up medical experts throughout the country and promised to give free medical care to melamine affected children.
October, 2008	Sanlu's president and three other top executives were detained related to the incident.
October, 2008	Chinese government confirmed that all milk products produced after 14th September 2008 to be free from contamination.
December, 2008	Sanlu declared bankruptcy with a net debt of US$ 160 million.

The government investigation showed that 22 manufacturers of infant milk powder were selling melamine contaminated products (Xiaojing, 2011). The incident was first found in Sanlu group which was the biggest infant milk processing firm in China. Sanlu's milk powder ranked first in the milk powder market which captured 18% of the Chinese market share for 15 consecutive years (Xiaojing, 2011). Annual sales reached 10,000 million yuan in 2007. In 2008, the consumption of melamine contaminated milk caused kidney stones in infants and this incident led Sanlu Group to receive bankruptcy order from the court.

Poor health of cattle, lack of protein content in the milk and competition between farmers could be the reason behind the milk adulteration. Cattles with lack of resistance to disease often had milk which was less in fat and protein content. Due to price constraints, lack of quality measures and insufficient use of disinfectant while milking the cattle raised by small

scale dairy farmers provide milk with low protein content when compared to the large scale farmers (Qian, Guo, Guo & Wu, 2011). The price rise in the cattle feed also reduced the profit margin for the dairy farmers. It forced the farmers to provide the cattle with less expensive feed which had an indirect drawback on the productivity of the cow. Providing the cattle with poor quality feed also had an impact on the fat and protein content of the milk produced.

So the public trust for milk was lost and people began to think about food safety measures. The consumption habit of people changed from milk to soya milk. Due to the consumer disinterest, sale of dairy products were dropped which forced many companies to reduce the production. Dairy farmers dumped large quantities of raw milk and they also slaughtered their cows which reduced the production (Qian, Guo, Guo & Wu, 2011). Many countries banned Chinese milk products which further affected the dairy industry.

In China commonly used methods of protein analysis do not distinguish whether nitrogen is from protein or non protein sources (Xiaojing, 2011). Addition of melamine caused a misleading high protein reading. Melamine was sold to food companies instead of treated as industrial waste. Investigation showed that melamine had been deliberately added to boost the protein content in the milk.

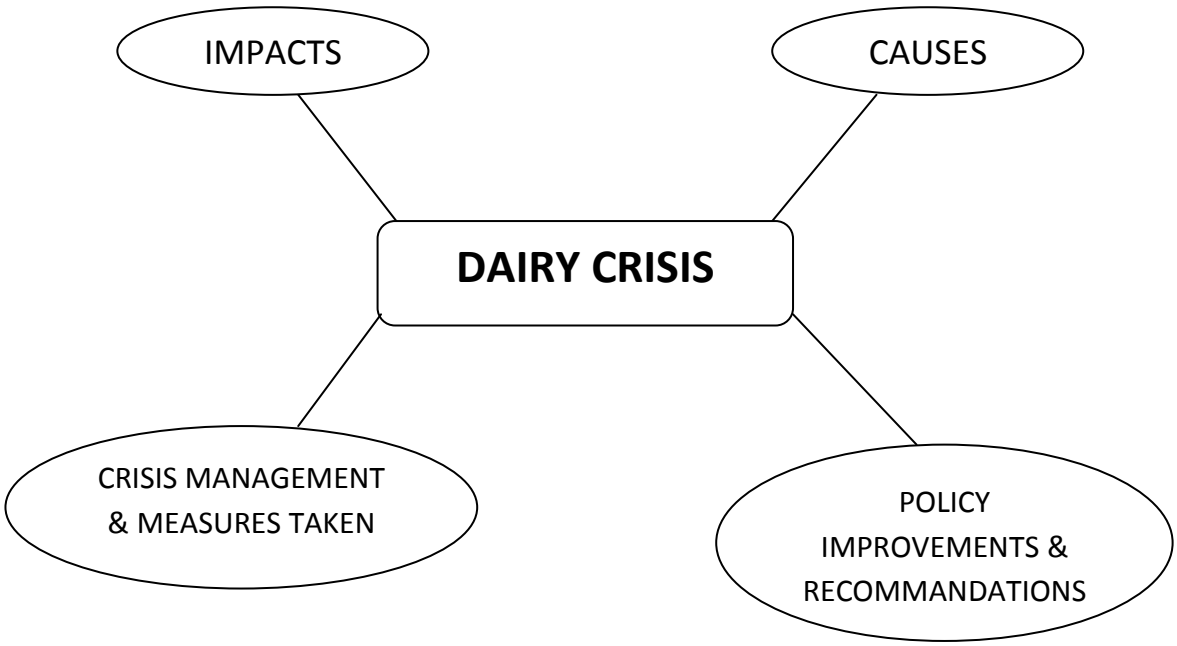


Figure 5: Impacts, Causes, Measures taken and Recommendations of Melamine dairy crisis

The melamine adulteration crisis came into limelight when the infant illness frequency has increased in the year 2008. Kidney stones in infants, related diseases, deaths and hospitalization of infants have increased rapidly in September 2008 (Yang et al, 2009). Infants who used the infant formula produced by the major dairy firm Sanlu had different kidney related diseases and ailments even prior to the September 2008 milk adulteration crisis. Kidney related issues and deaths forced the government authority to tests the milk products produced by Sanlu and other major dairy firms (Qian, Guo, Guo & Wu, 2011). In September 2008, the samples of milk from these firms were tested positive for Melamine and other harmful contents. Test reports showed that Melamine content was found in the milk products produced between January 2008 and September 2008. Later Sanlu group has agreed to the test report saying that some baby formula was contaminated. Baby formula manufactured by 22 dairy firms tested positive for melamine. It includes the major dairy players in China like Sanlu Group, Yili Group, Mengniu Group and the Guangming Group. Liquid milk produced by these firms also contained Melamine.

4.2.4 IMPACTS OF MELAMINE MILK CRISIS

The melamine milk crisis has caused great panic in China. Such as health damage to infants, great economic loss for dairy farmers and dairy companies. In November 2008, six babies died and close to 30000 children suffered kidney and urinary problems (Yang et al, 2009). According to figures, 99.2% of infants were less than 3 years and 0.8% was more than 3 years (Yang et al, 2009). The adulteration crisis had a major impact on China's dairy industry as a whole, farmers were negatively affected, milk processing units were impacted, had an effect on the supply chain, logistics firm and government agencies were blamed for inadequate quality and safety measures.

Dairy firms and related enterprises were impacted badly when customers lost the confidence in the dairy products. Firms had huge costs associated with the scandal such as recall of dairy products from the outlets and supermarket shelves, dumping of highly contaminated milk products and also costs related to processing unit cleaning and replacement (Sockett, 1993). Market share of the dairy firms collapsed and also there was loss related to the equipment, property, time and wealth. Certain dairy firms such as Mengniu Group suffered major losses and Sanlu Group went bankrupt in the year 2009. It

was mainly because of recall of products, further production was suspended by the government, export of dairy products came to an abrupt end and drop in orders. After the samples of milk products were tested positive, the stock prices of major players such as Yili Group and Mengniu Group plunged dramatically (Qian, Guo, Guo & Wu, 2011).

The crisis not only impacted the dairy firms but also the small and medium scale farmers. Dairy farmers had to deal with huge losses due to the crisis such as dumping of tons of litres of milk, milk cow shortage due to slaughter of cows and also the farmers had to deal with high cost of cattle feed for a better healthy cow. All these had a negative impact and it took months for the farmers to recover from such a state. At many instance the farmers had to bargain with the firms for a right price for the raw milk. At times it was unheard by the big enterprises and the farmers had to get satisfied with a minimum price for their hard work.

Melamine in milk products including baby formula was a serious food regulatory issue that had a major impact on the Chinese dairy industry. Price increase in raw milk in 2008 forced the dairy firms to procure substandard milk without paying much attention to the quality of the raw material (Gale & Hu, 2009). Dairy firm's quality standards varied according to market demand. Firms were willing to procure raw milk of any standard and from any supplier when the market demand for milk was more or when the raw milk supply was scarce. Procurement behaviour changed when the market situation was opposite.

The adulteration scandal had an impact on the customers as well. Customers lost confidence in the dairy products and baby formula after Melamine was detected. The crisis has forced the customers to purchase and depend on international dairy brands and the sale of imported dairy products rose considerably during this period. Around 50% of the loyal customers had fully ceased the use of domestic dairy products. The scandal not only affected the domestic customers but also the foreign markets which continuously imported the dairy products of China have lost trust in its products and also with the food safety regulations. Some countries such as Japan, Singapore, Africa, Malaysia, Indonesia etc have fully banned the import of dairy products and infant formula from China and also released media reports saying that Chinese dairy products were no longer safer.

The crisis revealed certain root problems in the supervision and quality system of dairy industry. Adequate focus on quality at the production and milk processing stage was not

taken into consideration. Supervision at the milk collection stage was inadequate which led to illegal practises. Rules and regulations were outdated from the government perspective and the concerned authority had lack of ability to control the situation (Qian, Guo, Guo & Wu, 2011). Before the crisis certain top dairy industries were exempted from the national inspection and some firms took advantage of this exemption and started to practice immoral production methods and produced poor quality products.

4.2.5 CAUSES OF THE DAIRY CRISIS

The root causes for China's dairy crisis can be discussed in four aspects. They are issues in dairy industry, Unreliable raw milk supply, Different dairy products and inappropriate profit allocation.

- Unregulated growth: The number of dairy firms increased from 500 to 2000 between the years 1982 to 2006 (Tan et al, 2007). In the year 2007, Chinese Yen 10 million were invested in the dairy industry of which close to 9 million were used to develop new projects (Qian, Guo, Guo & Wu, 2011). In 2007, 736 dairy enterprises had annual sales revenue of more than 5 million Yen. However 12 enterprises were large scale and had a profit of 31.3% and their assets were 28.3% of the whole industry. Medium size enterprises were 126 firms which formed 17.1%. They had a profit of 32.5%, sales revenue of 42.9% and assets of 45.9%. Small enterprises were the largest group which made 81.5% of all dairy enterprises. Out of this 25% were unprofitable firms (Qian, Guo, Guo & Wu, 2011).

  According to figures, profit margin for large enterprise was 49% and for small one was 8% (Qian, Guo, Guo & Wu, 2011). Small enterprises entrusted large enterprises to produce for them and they bought products directly from them and repackaged them for final sale. Due to such production there was less supervision. Enterprises of different size are required for efficient functioning of dairy industry. To meet the diversity of demand Chinese government supported not only large competitive groups but also big domestic enterprises and mini enterprises. Many small enterprises were involved in the scandal. There was a need to prevent Chinese dairy market from becoming a monopoly of big markets.

- Unreliable raw milk supply: There were three main sources of raw milk supply before the melamine crisis (Wei, 2008). Of the total raw milk supply 10 – 15 % was provided by enterprise owned farms. 25% were from dairy plots and milk collecting stations. 60% of raw milk supply was from individual farms. Milk collection often takes place at milk stations and they are the link between dairy firms and dairy farmers. There were 5 types of milk stations. Milk station run by dairy enterprises, those managed by large scale dairy farms, those managed by dairy plots, those managed by private farms and mobile milk stations (Wei, 2008)

  There are 20,300 milk stations across China. 63% was contributed by private milk station and mobile milk stations (Wei, 2008). Without efficient control from the government these stations could easily use prohibited measures to increase their profits. 25% of the total milk stations have commercial and business license and only 14% have hygiene license (DAC, 2008). Research shows that only a small number of milk stations were run by dairy enterprises, whereas most were managed by individuals, majority did not had license (DAC, 2008). It was difficult to control milk quality when supply chain of a big enterprise was widely distributed across the country (Wei, 2008). The milk provided by enterprise owned farms was not sufficient to meet the demand and as a result some companies purchased raw milk from other sources and their quality was unreliable (DAC, 2008). This was one of the major reasons for melamine scandal.

- Lack of variety in dairy products: In China the variety of dairy products is limited. Almost 80% of raw milk is used as liquid milk and for milk powder (Qian et al, 2011). Pasteurized milk comprise of 60% of dairy products in 1991. Ultra high temperature treated milk was 21%. In 2003, UHT milk rose to 59% while pasteurized milk decreased to 23% (Qian et al, 2011). Total production of milk in China was 12.4 million tonnes in 2006 (Qian et al, 2011). Milk powder constituted 80% of the total production. Cream was produced in limited quantity and there was no cheese production in China (Wei, 2008). Whey powder which was the main ingredient of milk powder was imported from other countries (Gale & Hu, 2009). Pasteurized milk can be preserved for one week at low temperature. So it was not suitable for long distance and trans-provisional transportation. UHT milk is sterilized at high

temperature and therefore can be preserved for one month. The melamine event mainly influenced baby's milk powder and UHT milk and no melamine was detected in pasteurized milk (Qian et al, 2011). It was easy to adulterate raw milk used for UHT production because it was less strictly controlled when compared to that of pasteurised milk. Raw milk was adulterated to achieve higher profits.

- Inappropriate Profit Allocation: There are four components in China's dairy supply chain. They are consumers, dealers, producers and providers. Providers are of two types, those supplying raw milk and those specializing in packaging. According to a research of dairy supply chain in Heilongjiang Province (Li et al, 2008), cost and profit of cow breeding, milk collection, product processing and retailing are unbalanced (Li et al, 2008). Milk collectors have high profit while processing enterprises have less profit. Individual dairy farms get the lowest profit when compared with dairy plots (Lin and Long, 2008). The dairy farmers have to invest more money while they are prone to higher risk with less profit. This is called "inverted pyramid", it is a sign of instability of the whole production chain in China (Lin and Long, 2008). The dairy enterprise has the lowest cost profit rate and there is also unfair competition. Chinese dairy enterprises, to get high profit buy raw milk from external sources instead of raising milk cows which makes difficult to control milk quality (Qian et al, 2011). When there is insufficient raw milk supply the competition for resources is always high, which is yet another major reason for melamine milk crisis.

4.2.6 CRISIS MANAGEMENT & MEASURES TAKEN

China's state council has set up a national leading group with officials from the health ministry, quality watch dog and local governments to deal with the tainted milk adulteration crisis (Qian, Guo, Guo & Wu, 2011). The government provided medical treatments to all sick babies and met all the medical expenses and the related costs. More than 1600 medical teams and 8000 people were sent all over the province to search for sick babies (Xinhua, 2008d). 4500 medical institutions in China participated in infant screening. 250 provincial and 2980 medical institutions were established in which infants were examined and treated for free (Yang et al, 2009). The government has formed a team with officials of central government department to handle the compensation issues (Xinhua, 2008b). The 22 dairy

companies which were involved in the contamination raised money to cover expenses for later illness until the child reaches 18 (Zhu & Xiaohuo, 2008). Parents of the victims also received compensation.

When the crisis came into limelight the milk production of major dairy firms were suspended. A team comprising of quality departments and health ministry was formed to inspect and maintain the quality of baby milk powder producers in China. All the members in the dairy supply chain including dairy farms, raw milk collection centres, dairy processing plants and milk powder production firms were under serious monitoring and supervision. Infant milk powder brands which did not meet the necessary testing requirements were removed from the supermarket and outlet shelves (Zhu, 2008). The feed which was given to the cattle was also inspected by the concerned inspectors. The purpose of such a quality check was to minimise the presence of melamine chemical from all sources (Xinhua, 2008a).

4.2.7 POLICY IMPROVEMENTS & RECOMMENDATIONS

The scandal forced the Chinese government to set up a series of quality control regulations for dairy firms and their products. Regular control and check were done on the milk cows and cattle feed, raw milk collection units and processing plants were inspected frequently. National quality testing methods along with safety standards and emphasis on hygiene requirements for milk products were made mandatory. The benefits of dairy farmers were also taken into consideration and to encourage farmers, several vital measures have been taken. Approximately $44 million was set aside by the government to help the farmers who have lost the business and money during the crisis (Yang et al, 2009). Cattle feed subsidy was also provided for the farmers to have a healthy milk yielding cows. New policy and insurance system were established (Zhu, 2008) to support the dairy farmers and their cattle.

To provide quality milk products to the customers the government conducted melamine tests on every batch of milk products produced after the 2008 crisis. This was done before the product entered the market (Zhu & Bolin, 2008). All the dairy products which were there on the shelves during the crisis were removed and had been dumped. The milk products to pass the melamine test must be tagged QS (quality safety) after the inspection. Only such products could be sold in the market. Products tagged with QS ensure that the quantity of melamine in the dairy product was within legal limits (Zhang, 2008).

Melamine milk crisis seriously endangered the growing dairy business in China. It also affected the reputation of Chinese goods in the international market (Xiaojing, 2011). Demand for cheap milk powder, lack of government supervision, government failure and market failure were the causes of Melamine crisis (Xiaojing, 2011). This incident had a great impact on government supervision, customers trust and awareness. Ineffective food safety control system was the main reason for lack of supervision. When too many departments are in charge of food safety it creates problems for low enforcement and there were conflicts with agencies and government at various levels. Lack of information exchange and coordination was another cause for ineffective administration. Crisis can be managed only by its credibility and responsibility to the society (Yang et al, 2009). But the Chinese enterprise was incapable to react properly. Dairy scandal was a bad example of crisis management and information clarity. For example, Sanlu Group refused to take responsibility about its contaminated baby formula for many months and did not openly admit that its products were toxic (Xinhua, 2008d).

There was no awareness of food safety in China especially among farmers and rural consumers. The affected children and babies were from rural areas. There was shortage of skilled laboratory staff, food safety technicians and management technicians for proper supervision and for frequent quality tests (Yang et al, 2009). Number of specialists with adequate knowledge about coordinated supply chain and contract farming were less during the crisis period.

China needs to reform its food safety supervision system and dairy production process. There should be an effective supervision system to support the enterprise and to improve the awareness of food safety. Further improvement is need in several areas:

- Food safety coordination should be strengthened.
- Monitoring network efforts of different departments and laboratories should be improved.
- Melamine and the input of other chemicals should be well tracked and traced throughout the supply chain.

- Focus should be to reduce the conflict in the supply chain and to strengthen the enforcement of regulations.

Joint effort by both public and private sector will intensify a good food safety control. Government should support establishment of fee for service testing laboratories, technical services and legitimate private certifiers (Yang et al, 2009). Government should organise periodic consultations with such associations on issues of food safety and should provide grants to promote food safety activities. Another step is to improve awareness among producers and consumers. Government should take measures to educate the general public about proper hygiene, safe use of chemicals and good agricultural practices (Yang et al, 2009). Databases and information based on web are very useful for food safety and to learn about health hazards.

Dairy crisis prompted the Chinese government to bring regular inspection of all food companies without exception (Qian et al, 2011). China took multiple actions to minimise the spread of the contamination, to solve the problem and was prepared for a similar crisis (Qian et al, 2011). All the contaminated factories were closed for inspection. Affected babies were treated free in hospital. All national quality control organizations inspected sample products from all dairy manufacturers and the results were made public. There were strict rules for milking station operations and for milk storage. Milk collecting stations needed approval from local authorities for the operations. China's top legislature approved the food safety law on 28th February 2009. The law would enhance monitoring and supervision, toughens safety standards, recall substandard products and severely punish offenders (Yuan and Wu, 2009). China's State Council had set up a food safety commission to strengthen the country's food monitoring system which has 5 departments with various responsibilities.

Manufacturers had to apply for license from ministry which was aimed to avoid melamine in food. Measures adopted by the Chinese government had positive results to improve food safety (Myint, 2000). Reforms will bring problems under control and minimise adverse consequences (Yuan and Wu, 2009). Dairy crisis can be tackled by dealing with the root causes by undertaking a series of measurements.

- The leading enterprises must be scaled up to strengthen the competitive capability (Schiere et al, 2007). Moderate scale dairy farms should be encouraged. Commercial,

ecological and social benefits will be gained by supporting the informal sector which provides milk (Myint, 2000).

- The dairy enterprise should optimise the products and the government should encourage innovating new value added products.
- The large range of production systems also implies variation in collection and processing modes to guarantee hygiene and preserved raw milk (Payne et al, 1999).
- There should be adequate safety, quality practises and control throughout the milk supply chain (Payne et al, 1999; Qian et al, 2011). A combination of leading enterprises and small farms is the best way to sustain small holder dairy production and marketing in China.
- Farmers, dealers and processing industry as a whole should endure to ensure food quality throughout the supply chain (Demirbas et al, 2008).

4.3 FONTERRA BOTULISM

4.3.1 OVERVIEW OF THE CASE

This particular case introduces to New Zealand dairy industry and about the firm Fonterra. Fonterra botulism of 2013 and a timeline of the incident are explained in the second section. Impact of the Fonterra crisis and how it is related to supply chain network is further studied. Risk management categories, measures taken, policy improvements and recommendations are further explained in various other sections. Fonterra botulism is the second case studied in the stage two of three stage research approach.

4.3.2 INTRODUCTION

Milk is a valuable source of essential nutrient for the infants. Dairy is of utmost importance to New Zealand economy. Dairy products have been an important dietary component particularly for young children. So the dairy industry is especially sensitive to contamination scares. Fonterra is New Zealand's largest dairy firm and world's largest exporter of dairy products. Fonterra was formed in 2001 through the merger of Kiwi Co-operative dairy limited, New Zealand Dairy Board and New Zealand Co-operative Dairy Company (Stojkov, 2016). Fonterra is a co-operative group which are owned by farmers and is the world's fourth largest producer of dairy products with a turnover of close to NZ$ 20 billion. It is a multinational company exporting products to over 140 countries and holding market leadership positions all over Australia, New Zealand, Asia and South America (Fonterra, 2013). According to the quantity of milk they supply to the company each farmer gets a share from Fonterra Co-operative Group (FCG). This is called share standard or wet shares. They can also own excess shares which are known as dry shares. Farmers who are not investors cannot own Fonterra Co-operative Group shares.

New Zealand is the world's largest exporter of dairy products and exports more than 50% of the total Whole milk Powder in the world (Fonterra, 2011). Dairy export is the main source of income for the New Zealand economy. Of the total New Zealand export, dairy constitutes for 26% (NZIER, 2010). Dairy Industries are also the largest sector for employment opportunities. People are employed in dairy farms and manufacturing plants (NZIER, 2010).

Fertilizer and cattle feed industries have also grown as a result of increased production in the dairy industry.

A nationwide recall of dairy products produced by Fonterra was done in the year 2013 when their milk products were tested positive for botulism causing bacteria. The contaminated dairy was even sold to other third party firms to produce baby formula and energy drinks. China being the main importer of Fonterra dairy products established a temporary ban on Fonterra's dairy products.

95% of New Zealand's dairy farmers were Fonterra's clients and had an export percentage of 95% in 2014 (Stojkov, 2016). By mid 2015 farmers representation had fallen to 87% (Brettkelly, 2015). Due to the fall in the representation, international firms such as Danone and Yashili purchased production plants in New Zealand. 15 million tonnes of dairy products are produced in New Zealand in a financial year. According to 2013 statistics 8% of the dairy goods produced globally and 2% of global dairy sales were from Fonterra (Fonterra, 2013). The firm also had number of international partnerships which include Nestle and dairy farmers of America. Over the years Fonterra's production expanded globally and the aim was to brand their product as high quality dairy products. They were moving to establish a position which is equal to China. They also had offices in other Asian countries. Recently they founded "Europo" a company that provides European procured Whey protein products to the European market (Fonterra, 2013). They also expanded its production in South America. Its efficiency in expanding globally shows that New Zealand has a strong reputation for producing quality dairy which is profitable (Fonterra, 2013).

4.3.3 FONTERRA BOTULISM OF 2013

Dairy industry is always at risk to contamination scares. In February 2012, during the manufacture of whey protein concentrate - 80% (WPC80), there was an abnormal pressure reading on one of the dryer in the Hautapu plant, Waikato. The operator in charge suspected a blockage and while checking the torch of the operator was accidently sucked into the pipe (Government Inquiry into the Whey Protein Concentrate Contamination Incident, 2014). The suction was so powerful that the pipe pulled the operator's hand. The torch which was there in his hand hit the pipe and the plastic lens was broken into pieces. Certain pieces of the lens went into the manufacturing machine. The incident was notified

to the team leader but they failed to take the necessary steps and production was continued, thinking how such a huge piece of lens could pass into the fan radiator. Next day the incident was reviewed by the plant manager and production was immediately stopped for a full inspection. A risk was sensed that the missing lens pieces could have end up with the whey powder.

Fonterra had later confirmed that 38 tonnes (3 batches) of whey produced in May 2012 was contaminated by a bacterium that could cause botulism under certain environment conditions (Government Inquiry into the Whey Protein Concentrate Contamination Incident, 2014). Botulinum is a gram negative, anaerobic, spore forming bacteria. The spores are resistant to heat treatments that kill bacteria. When the spores germinate they produce a toxin which blocks nervous function and can cause blurred vision, slurred speech, dry mouth, paralysis, respiratory failure and death. Infants are most affected by these bacteria because their digestive tracks are not as acidic as those of adults.

The bacterium which came out of soil had entered through a pipe line in a particular factory. This was the real cause of contamination and the pipe line was a rarely used one. The contamination was blamed on unsterilized pipes used to move the whey during production (ASB, 2013). The affected product was produced in May 2012. Fonterra discovered the presence of bacteria in March 2013 when they were producing a dairy product for a client. Results from the testing revealed the presence of Clostridium Botulinum, which can cause botulism under particular environmental conditions (ASB, 2013). 870 tonnes of products were manufactured from affected batches of whey. 8 customers of Fonterra were affected while retail brands were not affected. Affected countries were New Zealand, China, Saudi Arabia, Thailand, Malaysia, Australia and Vietnam. Fonterra also confirmed that fresh milk, whole milk powder, skim milk powder, yoghurt, cheese spread, UHT milk was not affected by this incident. Also the products they sell on its global dairy trade were not affected. Fonterra also claimed that products made with whey were safe to use due to the production process (ASB, 2013).

Fonterra indicated that botulism toxin can be only produced in anaerobic conditions. Spores developed by the bacteria needed warm temperatures and anaerobic environment and moisture in order to become active and to produce toxin. It is the toxin that is dangerous

rather than the bacterium. Whey protein was used in many products such as beverages, food supplements and infant formula. Fonterra took immediate steps and recalled $15 million worth of product to prevent consumer harm. Quick action was taken to clean the spoiled pipe line. Despite all the action China, Vietnam and Russia banned Fonterra's dairy products. The incident lost consumer confidence and world milk price dropped badly.

After the incident, studies show that the contaminated material was recalled and secured. Whey protein isolates are the purest form of concentrated whey protein. In the year 2013 till May 96,203 MT of whey were exported from New Zealand (Bagrie and Williams, 2013). So the contaminated 38 tonnes accounts for only 0.04% of the total export in the last 12 months. North America (50%) is the largest importers of whey from New Zealand, followed by Asia (13.7%), China (11.6%), Europe (7.9%) and Russia (7.7%) (Bagrie and Williams, 2013). Whey protein is a by product of cheese production process. US and Europe are the main manufacturers of cheese and thereby dominates the whey trade as well.

4.3.4 TIMELINE OF FONTERRA BOTULISM INCIDENT

Table 4: Timeline of Fonterra Botulism Incident

FEBRUARY, 2012	A torch was sucked into a whey processing machine at Fonterra's Hautapu plant in Waikato while manufacturing WPC80. Production was continued and 38 MT of WPC80 was affected.
May, 2012	Fonterra has later confirmed that 38 tonnes (3 batches) of whey produced was affected by the incident.
June, 2012	Hautapu plant prepares for a major rework on its 2 hoses and a pipe. It was inadequately cleaned and SRC contamination occurs as a result. Risk management programme was not followed rightly.
March, 2013	Fonterra discovered the presence of bacteria when it went to use some of the whey to manufacture a product on behalf of a client. The product was later rejected by the client due to high level of sulphite

June, 2013	Fonterra launches an investigation after the advice that botulism causing bacteria may be the reason behind contaminant.
July, 2013	Testing confirms the presence of Clostridium Botulinum. Discussions are being held between the management and Fonterra staff to decide what to do with the customer rejected products and other affected product which are already been sold.
July, 2013	Tracing efforts are done to locate the contaminated products. Fonterra made a media report stating that there is a quality issue in its products and a precautionary recall is in place. Fonterra announces that all of the contaminated products have been located.
August, 2013	Fonterra conducted further testing at accredited laboratories in the US and found out that the cause of contamination was not Clostridium Botulinum but it was as a result of Clostridium Sporogenes.

4.3.5 IMPACT OF THE FONTERRA CRISIS

Fonterra had been fined $300,000 by the New Zealand government for causing the crisis and for also damaging the international trade reputation of the country. Crisis also affected the performance and the reputation of the firm. Fonterra even faced legal charges for causing the botulism, a rare and severe form of food poisoning in the infant formula (Rutherford, 2014). During the crisis, New Zealand's major trade partner China even hesitated to do any dairy business. The scandal resulted in the resignation of Gary Romano who was the head of Fonterra's milk division.

Fonterra reworked some of its concentrated whey through temporary pipe line at the Hautapu plant in Waikato (Government Inquiry into the Whey Protein Concentrate Contamination Incident, 2014). But it was not approved by the legal committee. This increased the risk of bacteria. The ministry for primary industries brought many charges under the animal product act against the company for its failure in producing the dairy

products in accordance with risk management programme. Even the export products did not meet the animal product standards. This incident totally damaged the high product quality reputation of New Zealand. Many dairy products which were 100% safe were also shaken and the world lost its overall confidence on New Zealand dairy products. New Zealand's access to number of foreign markets was also impacted. Raw milk suppliers and those associated with Fonterra had to undergo many financial burden.

A Chinese consumer watchdog group said four domestic manufacturers Dumex baby food company, two subsidiaries of beverage manufacturer Wahaha Group and Shanghai Sugar, Tobacco and Alcohol firm had potentially imported contaminated products (Naomi, 2013). Fonterra said that Coca-Cola's Chinese subsidiary was also affected (Naomi, 2013). Coca-Cola claimed that 4775 out of 4800 kilogram of contaminated whey had been quarantined before using it. The remainder was used in a single batch of Minute Maid Pulpy Milk and this was also recalled just to reassure the consumers even though there was no health risk as the drink was heat treated to kill bacteria (Naomi, 2013).

Internationally 8 companies were affected. Among this three were food companies, three were animal feed producers and two were beverage companies. Danone Dumex, Malaysia stated that the products were tested and was free of contamination. But they took a precautionary recall of four batches of infant formula. Karicare formula which was an affected product made by Nutricia was directly sold to consumers by Fonterra (Naomi, 2013). Fonterra CEO, Theo Spierings ensured that no dangerous products was used by consumers and he said that most of the consumer products affected were not manufactured by Fonterra, individual manufacturers were responsible for the recall. He also travelled to China to deal with the issue because China was one of the main importers of New Zealand dairy products.

RESPONSES FROM FEW COUNTRIES

China took immediate measures to prevent the issue by ordering importers to recall any infected products which harmed the health of Chinese consumers. China temporarily suspended the import of all milk products from New Zealand. China imports US$1.9 billion of milk powder a year out of which 90% originates in New Zealand (ASB, 2013). Due to the botulism crisis there was a shortage of dairy products in China.

Thailand ordered a recall of all Fonterra products imported since the crisis. Russia also stopped the import and sale of Fonterra products. Sri Lankan health ministry issued an island wide recall of all suspected milk stocks from New Zealand and also from the local Fonterra firm. The Sri Lankan government also banned the advertising activities of Fonterra Brands Lanka (Pvt) Ltd**.** But no casualties have been reported related to the crisis.

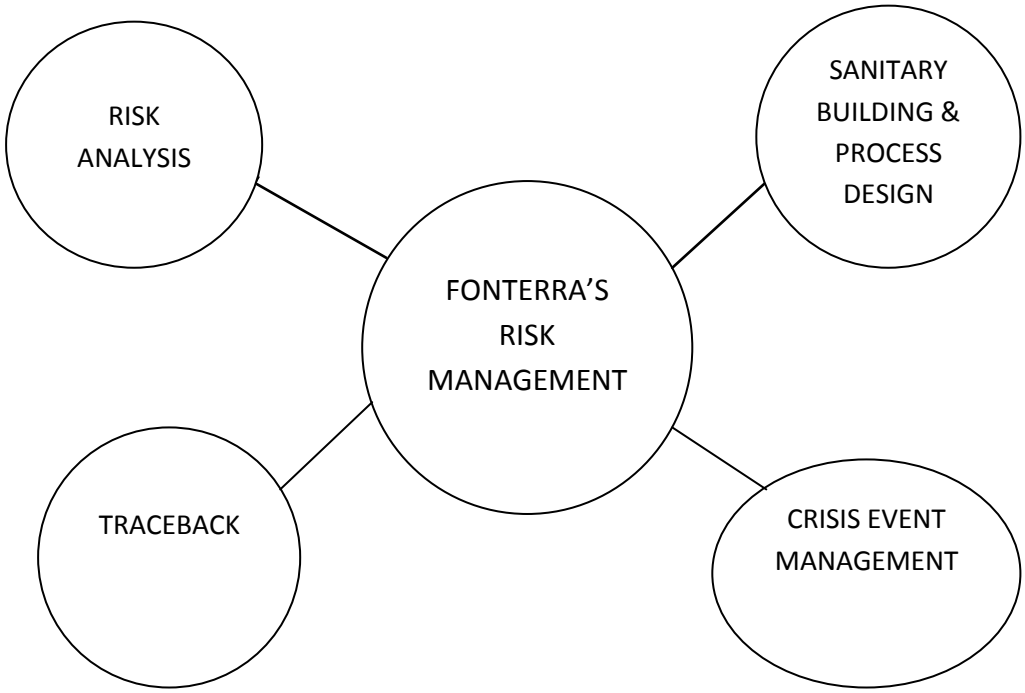
French Food Company Danone which owned Nutricia brand demanded 300,000 million Euros for the damages caused. But Fonterra was only ready to settle with $NZ14 million. The Australian department of agriculture, fisheries and forestry were informed of a possible contamination of a dairy food ingredient, whey protein concentrate exported to Australia (The Courier, 2013). Australian government was also working with New Zealand authorities to identify any food safety implications for consumers in Australia (The Courier, 2013).

Parents in New Zealand were also asked to stop using Karicare formula products for children after this incident. Five batches of Nutricia Karicare formula were tested positive with the contaminated whey powder (Naomi, 2013). About 38 tonnes of whey protein concentrate at Hautapu plant in Waikato were contaminated by unsterilized pipe line in 2013 (The Courier, 2013).

4.3.6 FONTERRA'S RISK MANAGEMENT

Risk management at Fonterra has four categories such as risk analysis, sanitary building and process design, trace back and crisis event management.

Figure 6: Risk Management at Fonterra



Understanding and analysing the risk is of utmost importance. Risk should be analysed by taking into consideration the potential hazard it can cause. Analysis of the potential hazard could improve and prevent future risks. Contamination and microbiological bacteria can be avoided by having a frequently updated sanitary building and process design. Best industry practices should be adopted to reduce the food safety risks and to have a high quality product. Employees should be trained well on a regular basis on their skills, knowledge and tools to improve the operations and to reduce the risks. Trace back of bacteria which can cause a positive contamination is vital for an effective process control. Bacteria should be traced back to its source as quickly as possible to effectively prevent product loss and further contamination. Failure to trace back the source of bacteria can result in a health crisis which can affect the reputation and performance of the brand and the firm. Crisis event management is necessary for an efficient, effective, on time recovery and for a clear view on how to respond in a crisis situation. A delay in response can incur huge financial losses and can damage the reputation of the firm.

4.3.7 MEASURES TAKEN

It is believed that the milk contamination which originated at the plant could have been occurred at the dairy farm. Fonterra crisis is an example of how safety and quality of milk had a huge impact on world market prices of dairy products and the reputation of the firm. In Fonterra case just one positive bacteria test shattered the whole business of the firm. Truly speaking bacteria can be formed in every dairy farm and in every dairy processing plant. So every person involved in the dairy supply chain must be vigilant that their practises and processes should promote the production of milk of the highest possible safety and quality.

All milk safety and quality starts at the farm. For example, “a good jockey can’t make a bad horse win but a bad jockey can make a good horse lose”. This means that good milk cannot be produced from bad raw milk but good raw milk can be harmed at the plant (Walker, 2013). So farmers and milk processors must be in a mutual reliant relationship. For the milk quality and safety farms must be taken into consideration. Supervisors should see that the farm is maintained clean and complaint free. Farms which are not in accordance with regulatory rules should be excluded from the market place.

Dumping the collected milk is an easy task and doesn't require much effort but this will greatly damage the dairy farm's bottom line. So farmers should be very careful about their safety steps. The primary aim of national and local dairy farm is to ensure that the equipment and facility are clean so that it is clean of disease causing germs. This doesn't mean that there should be expensive facility to keep the farm clean. National and local regulations also aim at protecting the safety of food produced at the farm. Regular inspections will ensure that the farm is up to the standard and free from all bacteria. Producing the milk according to these rules and regulations will keep the milk standard high (Walker, 2013). Such milk will be easily accepted in the market. Most market pay additional premium for high quality milk. These premiums are based on bacteria level, including the standard plate and the preliminary incubation counts, somatic cell levels and antibiotic residue and other adulteration tests (Walker, 2013).

Pasteurization has greatly improved milk safety and there was no sterilization of milk. But some bacteria can survive pasteurization and there by create problem in the final product. So depending upon the species these bacteria can impact the texture, consistency, flavour, shelf life and milk quality. They can also cause serious food poisoning and death. Staphylococcus aureus bacteria can cause food poisoning by growing in warm milk and by producing harmful toxins (Walker, 2013). Stomach cramps, vomiting, diarrhea and nausea are some of the symptoms of such a bacteria attack. For proper food safety, cooling down of milk at the right temperature is essential. High somatic cell levels could impact the dairy products flavour, spoilage and can harm the product quality. When the milk has a somatic cell count (SCC) which was greater than 400000 (used to produce yoghurt), it affects tastes and shelf life after 20 days (Walker, 2013). Milk with low SCC has high flavour and can be stored up to 7 days than high SCC milk. So processors were willing to pay extra premium for low SCC milk. Cows with low somatic cell counts produce more milk over the life time. So the real reason for food safety and milk quality are truly important.

Consumers always want a safe nutritious product that will not cause harm to them or their family. Processors should be supplied with raw material that will yield an appealing and saleable product. So there should be great awareness in the milk production otherwise one batch of bad product can have a huge impact on world market and on consumers trust. So farm milk should be tested frequently and if there is a negative result it should be rectified

immediately. Make sure the milk processing pipe lines are safe and clean. Individual diligent will be of great benefit to the farm and the entire dairy industry. So the customer confidenc e on the product should be never lost.

4.3.8 POLICY IMPROVEMENTS & RECOMMENDATIONS

2013 botulism scandal highlights the need for fast and accurate testing and identification of sub standard products. New Zealand is recorded as the number one world leader in the production and export of dairy products. The dairy industry forms a large part of the country's exports. Botulism scare of 2013 affected not only Fonterra's reputation but also New Zealand's reputation as an exporter (Bagrie and Williams, 2013). With this incident dairy firms learned how to be diligent in each and every step of production which will benefit the dairy industry as a whole. Creating a food safety culture is not a solo affair. It requires the application of best signs with best management and best communication systems. Until and unless there is a mutual relationship between the farmers and milk processors there won't be a high quality product.

When manufacturing food and dairy products for consumers, product safety is the number one priority. Having a product risk management strategy in place will protect the brand, reduce the financial risk and ensure safer products for consumers (ASB, 2013). After the crisis, there was an expert assessment team to assist the business to make it free from risk management. Fonterra offered both preventive and crisis management services. They developed a contingency plan for serious events such as product recalls and in the event of a product safety break down a rapid response team assisted in tracing the cause, resolving the problem and finally protecting the brand. As an exporter of dairy products to 140 countries and with consumer business in selected markets Fonterra learned how to manage the product risk and to gain consumer confidence (Bagrie and Williams, 2013). Fonterra had a product assurance process available to support the customers in reducing the costs and risks associated with a product failure.

Fonterra has a number of specialists and techniques to understand the need of the customers and also for the deep understanding of the environment and market in which they are operating. Such a unique advantage helps the firm to manage the product risk in an appropriate way and thereby safeguarding the reputation of the firm.

Measures for a high quality Dairy Product: To create a safe and quality dairy there should be certain measures such as proper leadership, managers and supervisors, confidence of the employees, accountability, communication and guidance.

- Senior management must create a safety vision, set expectation and inspire others to follow. A safety measure starts from top to bottom.
- Managers and supervisors must show their support and demonstrate their commitment for safety in practical ways.
- Staff must keep in mind that firm's main aim is safety and quality.
- All employees must understand what they are expected to do to uphold the food safety standards and each employee is accountable for their performance.
- There must be a regular sharing of information and proper communication at each level and department.
- There should be proper guidance, encouragement, reward and disciplinary action for false behaviour.

Fonterra has many short, medium and long term goals. It is undertaking a series of system of upgrades and a well established tracking system where any production can be traced in 48 hours (Government Inquiry into the Whey Protein Concentrate Contamination Incident, 2014). In 2015, further improvement has been made to cut the tracking time to 24 hours and later it was reduced to 3 hours by the end of 2016. In 2017, it aims to give consumers instant online access to a products history (Government Inquiry into the Whey Protein Concentrate Contamination Incident, 2014). This performance will be enhanced through improved systems such as updated product identification, labelling and coding standards. The firm is also writing traceability and recall protocol into customer contracts.

After the botulism crisis, the dairy firms adopted certain key features for a strong dairy safety culture. Senior management should have a strong leadership skill which starts at the top of the organization and flows downward to other departments. The top leaders should inspire the subordinates and set expectations to them. Middle managers should support and work towards the safety and quality of the dairy products. All employees should be

accountable for the safety standard and quality of the milk. There should be proper communication and information flow between top management and employees. Dairy firms started to adopt practises to encourage, reward and reprimand behaviour.

Fonterra developed a communication-crisis master plan to deal with the unexpected incidents. Such a plan is suitable for local as well as national market conditions. Fonterra believes in transparent communication to retain the trust and confidence of its customers. Transparent communication is impossible without a proper coordination with customers, government officials and regulators. Fonterra provides regular training for all employees who have joined during the crisis period. There is training among individual business unit. This training is to support and participate effectively in any crisis period. In Auckland they have set up a dedicated space large enough to ensure a successful coordinated crisis response.

4.4 MORINAGA DRIED MILK POISONING

4.4.1 OVERVIEW OF THE CASE

An introduction about the Morinaga milk industry and various reasons which led to the dairy quality improvisation and dairy expansion in Japan is provided. Morinaga dried milk poisoning crisis and its causes are analysed in the next section. The final section explains the effects of arsenic poisoning and the impacts of the crisis on the supply chain network partners. Morinaga dried milk poisoning is the third case studied in the stage two of three stage research approach.

4.4.2 INTRODUCTION

Baby milk powder was first introduced in Japan during the Taisho Era (1912-1925). Morinaga milk industry is a milk product and sweets company which was formed in September, 1917. In the year 1920 they launched Morinaga dairy milk for infants and pasteurized milk. Their aim was to create a new food culture based on the excellent power of milk making a difference in people's health and society in general. They have joint ventures and subsidiaries in China, Germany, Indonesia, Singapore and USA.

After 2^{nd} world war dairy products were improved in quality due to various causes such as

- Creation of milk production capital.
- Rules and regulations relating to dairy industry were liberal.
- Market expansion of milk products.
- Excessive supply of raw milk for production.

During the years 1950 and 1954 production of milk products doubled in size. In 1951 due to the loosening of government regulations all dairy firms started to compete and expand their market with modified products by using new technologies such as vitamins and minerals. Each company started competing in milk production and started to create their own trade mark symbols.

Before 2nd world war period Morinaga firm had established a baby health examination in Tokyo and Osaka in corporation with doctors and nurses in order to promote its baby products. Import of milk products decreased in 1952. Milk producers started to compete for resource allocation. There was competition among companies and there was 50% increase in milk product production. But this business boom did not last and sale of milk products decreased during the year 1954 to 1955. The dairy firms suffered from high debts because of excessive stocks. So the firms tried to increase a demand for milk powder and increased production to meet the demand. By 1961, 70% of Japan's domestic trade was done by Yukijirushi, Meiji and Morinaga. During the period Morinaga rose to number one place in dairy products and 60% of total market for infant products was in their hands.

4.4.3 MORINAGA DRIED MILK POISONING

Profit oriented and mass production always results in deterioration and reduces the safety of the product. Japan Pharmacy Bureau for purity had authorised a particular soda for adding to the milk products (Shoji & Sugai, 1992). But instead of using this, Morinaga Company used low grade industrial material which was very cheap. From April to July 1955, 380 kg of industrial grade sodium phosphate which contained Arsenic were added to milk products which were not examined for purity or fitness for human consumption (Shoji & Sugai, 1992).

Arsenic was only present in the milk powder manufactured at the Tokushima plant. It was Morinaga factory in Tokushima who announced that arsenic had been found in sodium phosphate, a chemical used as a stabilizer (Tsuchiya, 1977). At that time there were no refrigerated tanker trucks for transportation, so the milk was becoming oxidised on long trips from the farm to the factory (Morinaga, 2012). Production of milk powder depends on the quality of raw milk used. If the raw milk is not up to the standard, it is difficult to get dissolved in the water. This was the main reason for Morinaga dried milk poisoning. The raw milk used was not up to the standard. So the processing firm had to use a stabilizer known as sodium phosphate. Since 1952 Morinaga had been using the stabilizer. The type of sodium phosphate that Morinaga had been adding to their milk was one for the industrial use which was used as an insecticide or for cleaning boilers (Morinaga, 2012). During this time the weighing scales at the factory were broken so the stabilizer was not measured

before addition. The amount of arsenic in each product differed. The sodium phosphate was delivered to Morinaga factory in Tokushima after being rejected by many medical companies (Tsuchiya, 1977).

Morinaga records showed that the dried milk had been contaminated with arsenic from 13th April 1955 (Dakeishi, Murata & Grandjean, 2006). The source was disodium phosphate product added to the cow's milk as a stabilizer to preserve constant acidity. Industrial grade sodium phosphate was of low purity and contained 5% – 8% of arsenic (Dakeishi, Murata & Grandjean, 2006). When this was analysed it contained tri sodium phosphate, sodium arsenate and several other impurities. During this time Tokushima plant manufactured approximately 200,000 pound cans of dried milk per months and this was mainly sold in western and eastern Japan. In August 1955, most of the cans were collected before being sold (Dakeishi, Murata & Grandjean, 2006).

Poisoning cases occurred during the period of 8th August 1955 to 30th April 1956. During these period 24 serious cases, 2005 surviving patients, 84 was suspected patients and infants aged 6 to 10 months were admitted with symptoms of arsenic (Dakeishi, Murata & Grandjean, 2006). There were patients from one month to 61 years of age. The first victim appeared in April 1955 and by July and August 1955 the incident reached its peak. It was difficult to estimate the total amount of arsenic poisoning in each case because the number of dried milk cans purchased by each family was unknown and dried milk was consumed not only by infants but also by other members of the family (Dakeishi, Murata & Grandjean, 2006). Based on the data from patients who used Morinaga's dried milk, the clinical poisoning was approximately 5 cans and a 2 month old baby would have consumed 5 cans in 2 to 3 months.

4.4.4 EFFECTS OF ARSENIC POISONING

In 1955, doctors in some part of Japan were worried about increasing diseases such as vomiting, fever, diarrhea, skin pigmentation and abdominal distention among babies who are less than a year old (Tsuchiya, 1977). The first infant patient of Morinaga milk poisoning was seen at Okayama University medical school hospital, later some other infants were also admitted to the hospital. On August 5th 1955, all the sick babies who were under treatment drank regularly Morinaga milk formula. On August 12th 1955, hospital authorities announced

that the babies were sick because of the consumption of Morinaga milk formula. On August 13th 1955 more babies were hospitalized in Okayama Red Cross hospital. On August 19th 1955, Professor Eiji Hamamoto of the paediatric department of Okayama University advised the production chief of Tokushima plant for further examination of the production process (Shoji & Sugai, 1992). The professor advised the Red Cross hospital to use BAL antidote for the patients who were affected by arsenic poisoning. On August 23rd 1955, medical department of the Okayama University detected arsenic in Morinaga's milk (Shoji & Sugai, 1992). A recall of Morinaga's dairy products from the market and closure of Tokushima plant of Morinaga firm was declared by the ministry of public health.

The arsenic milk crisis was broadcasted in radio, television and there was also newspaper coverage. Fearing for life and health of their new born babies, families rushed to the hospital. On August 25th 1955, Morinaga Milk Company placed an apology and petition in every newspaper and promised to promote the safety of their products (Shoji & Sugai, 1992). On September 30th 1955, an association was formed by the family of the patients and they made three demands in relation to the incident

- The company should pay all expenses related to the treatment and further hospital visits.
- Compensation in relation to the poisoning after effects.
- The compensation was 25,00,000 yen for each death caused, 700,000 yen for seriously affected cases and 300,000 yen for less serious cases (Shoji & Sugai, 1992). Since the firm was not responding to the demands set by the association, there was immense struggle to put pressure on Morinaga.

4.4.5 IMPACTS OF THE CRISIS

Morinaga dried milk poisoning incident happened during the early phase of Japan's rapid economic growth during the post world war period (Dakeishi, Murata & Grandjean, 2006). During this time milk powder and other dairy substitutes were marketed by three main dairy firms in Japan. There was fierce competition in the production field and because of this competition, food manufacturing industries did not pay any attention to safety measures. The company did not conduct any quality control measures or assessment of raw materials.

Morinaga dried milk poisoning incident led to several implications:

- Dairy safety considerations are crucial for large scale production of infant formulas. A deep understanding about the raw material would identify which additive to be used and would identify the toxic material contained in them.
- Failure from health authorities to handle an epidemic at the right time made the crisis worse.
- The clinical criteria established by the government authorities were rigid and misleading. Patients with severe symptoms were ignored and not provided with treatment and care they needed.
- The victims of this unfortunate incident failed to receive any support or compensation from the government.

Morinaga milk crisis had several international impacts as well. The serious poisoning incident was not well documented by the government to bring an adequate safety measure to the dairy industry (Dakeishi, Murata & Grandjean, 2006). Very little attempt was done to spread the news outside of Japan. The incident was not published well in English by the Japanese scholars or journalists. Even in documents and articles related to arsenic, a report on this particular unfortunate poisoning has been ignored (Dakeishi, Murata & Grandjean, 2006). Due to these reasons the world is not much aware about this very serious poisoning crisis.

Arsenic is the cause of peripheral neurotoxicity in adults. Arsenic concentration in the contaminated milk mixture was estimated at 4.2 – 7.0 mg per litre. The Morinaga milk poisoning event provides evidence for development of neurotoxicity. When infants consumed the contaminated milk for few weeks, the arsenic level went up to 60 mg and thus it alters the normal activity of the nervous system in infants and damaging the nervous tissue. The effects of arsenic on central nervous system development need to be further explored and included in future risk assessment. So it is needless to say that all producers have a responsibility to their customers when it comes to product quality (Morinaga, 2012). Lack of quality measures, security practices and proper health and safety regulations are the

main reasons which led to the dairy poisoning crisis. Morinaga neglected their duty of care and its responsibilities to the loyal consumers.

Morinaga insisted in the criminal court that they have been deceived by the medical company and that they did not check for quality. They blamed the medical company for deceiving them against the principle of trust. The medical company accepted the fact that they supplied a low quality product and also stated that they would have delivered a quality product if Morinaga had made it clear for what the medicine was used for (Morinaga, 2012). Morinaga wanted all these matters to be a very confidential one.

Morinaga firm insisted that the after effects such as eyesight problems, skin diseases, irregular physical development, mental disorders, difficulty in studying, irregular physical development were not a product of arsenic poisoning but rather symptoms of previous illness that has no relation with arsenic (Tsuchiya, 1977). The babies were suffering from an unidentified poison or disease and parents were forced to accept the baby's misfortune as it was of some kind of natural disaster and take responsibility for ongoing treatment (Tsuchiya, 1977).

4.5 SNOW BRAND CRISIS

4.5.1 OVERVIEW OF THE CASE

The case starts with a brief introduction about the Hokkaido island where Snow Brand firm was started. Next section deals with the dairy poisoning crisis of 2000. Causes of the crisis and the timeline of the Snow Brand crisis is further explained in detail. How it is related to the supply chain of the firm and its effects on the supply chain network partners is provided later on in the case. This section concludes with recommendations on mitigating a similar dairy crisis. Snow brand milk poisoning is the final case analysed in the stage two of the three stage research approach.

4.5.2 INTRODUCTION

Milk has a special status in the Japanese market since 7th century. People of various age groups drink milk believing that it is healthy and nutritious. After 2nd world war the Japanese government included milk in the daily school lunch program and also encouraged students to drink milk on a daily basis and thereby protecting the milk industry. In 1985 the product volume of milk was 4 million which has increased to 5 million kiloliters in 1994 (The Ministry of Agriculture, Forestry and Fisheries of Japan, 2003).

Hokkaido is a beautiful exotic Northern island in Japan. It was famous for agriculture and fisheries. Livestock industry is one of the main industries in Hokkaido. Milk products made in Hokkaido or companies from Hokkaido were attracted to consumers all over the nation. It's a popular destination for domestic tourists. Snow brand firm was born in Hokkaido in 1925 as a farmer's co – operative. Snow brand utilised the positive image of Hokkaido to strengthen its marketing position (Dawar & Pillutla, 2000). Snow brand was very famous in milk products but had to face severe blow in 1950. In 1955, there was a serious food poisoning case were 1900 students were affected by the food poisoning after drinking the skimmed milk made by Snow brands Yakumo Plant in Hokkaido. Hemolytic staphylococcus bacteria were found on a portion of fresh milk made at the plant where a mechanical problem and a power outage had led to a delay in germicidal treatment (Wrigley, Ota & Kikuchi, 2006).

Snow brand had a prompt and appropriate response to the food poisoning. Mytsugi Sato, the company president immediately announced to stop the distribution and ordered a recall and made an apology in newspapers and many other medias. He took further measure to prevent reoccurrence of food poisoning. President made an announcement to all employees regarding the crisis stating that "it takes a long time to gain credit and no time to lose it and it's only quality improvement that can result in regaining the honour that was lost due to quality contamination" (Shuzaihan, 2002).

4.5.3 DAIRY POISONING CRISIS OF 2000

Among the most dreaded situation for any milk producing company is the outbreak of food poisoning. For Snow brand, Japan's giant in dairy products, 2000 was the year of nightmare which shattered their business. The Snow brand company received the first report of food poisoning on 27th June 2000. After consuming the Snow brand milk products people started falling sick with food poisoning. Dairy poisoning at the Osaka plant of Snow Brand Company left 14780 people ill and this was reported on 27th June 2000 (Nakao, 2002). The original cause of poison was due to a power failure at Taiki plant in Hokkaido which forced the firm to stop production. As a result bacteria started to accumulate and led to a toxin. Dairy products which contained the toxin material was shipped from the Osaka plant and caused an outbreak of food poisoning.

On 28th June 2000, the Osaka government had asked the Snow brand firm to stop production and also to recall the contaminated dairy products from the market. Due to the delay in proper communication and direction towards the recall of products from the top management it resulted in an accelerated spread of the disaster (Nakao, 2002). On 2nd July 2000, Osaka institute of public health detected bacteria named staphylococcal enterotoxin type A in the low fat milk (Nakao, 2002). On further examination Enterotoxin type A was found in skimmed milk powder which was produced on 10th April 2000 at the Taikai plant in Hokkaido. Osaka institute of public health identified it as a food poisoning agent and prohibited the operation of the Osaka plant. On 11th July 2000 Snow brand suspended production of dairy products at 21 plants. Due to this poisoning incident, Snow brand tried to improve the quality and credibility by upgrading the production techniques and by expanding the plants.

The incident caused the Snow brand to lose consumer confidence and the sales of the largest dairy manufacturer. On 25th July 2000 the health ministry authorised the reopening of 10 plants and they began production the next day. Operation was started in 20 plants by August. But consumers continued to boycott the products of Snow brand. The total liability during this time reached close to 53 billion Yen and the firm had to close two plants including the Osaka plant (Nakao, 2002).

4.5.4 SNOW BRAND MILK POISONING – CAUSES

Since June 2000, Snow Brand has been facing many issues. Company's problem has started with food poisoning caused by the bacteria. Many investigations have been conducted by the government revealed that there were unethical practices inside the company. They violated many food regulatory laws. The victims suffered from diarrhoea, stomach pain and vomiting and some were hospitalized after consuming the contaminated milk.

- The bacteria which entered the production cycle as a result of power outage was send to the next level of production without being discarded.
- There was lack of basic knowledge about food sanitation and Osaka plant did not have a proper sanitary precautions.
- There was lack of awareness about crisis management. Firm failed to take necessary action at the time of power outage.
- The contaminated dairy products were shipped from Osaka plant to various markets which further aggravated the food poisoning.
- President of the firm being a financial expert had no knowledge about technology or production.
- As the industry leader, there was false pride, impression that they have a technological superiority and proper communication. All these factors resulted in not analysing the situation well.
- Quality of labour was lowered when experts in the firm were cut down.

- There was no frequent quality inspection or plant inspection for a high standard product.

4.5.5 TIMELINE OF SNOW BRAND CRISIS

Table 5: Timeline of Snow Brand Crisis

June, 2000	Snow Brand received first phone call stating about the food poisoning. Several food poisoning reports have been received at the Osaka City Hall.
June, 2000	Production unit investigation was carried out at the Osaka plant by the Osaka City Hall. Snow Brand dairy product recall was made mandatory by the Osaka city Hall.
July, 2000	Snow Brand confirmed about the contamination. 6121 victims were reported by July. Osaka plant was shut down. All dairy products from Osaka plant were recalled.
July, 2000	Number of affected people exceeded 10,000. Snow Brand announced that 21 processing plants nationwide are shut down. Ishikawa the president of Snow Brand resigned from his post.
August, 2000	The new CEO, Nishi has taken charge of the firm. Restructuring plan of the firm has been put forward by the new CEO.
August, 2000	Hokkaido government and police had conducted on-site investigation at the Taiki plant which was the source for food poisoning.
August, 2000	Snow Brand admitted that the contaminated skim milk was shipped from the Taiki plant which caused the food poisoning.
March, 2001	Snow Brand was reported with a fiscal deficit.

4.5.6 EFFECTS OF THE CRISIS

Food poisoning caused a rapid decrease in sales of the Snow Brand dairy products. The company updated its manufacturing facilities to prevent similar incidence and was considering launching a new brand to replace the Snow Brand (The Japan Times, 2000). Due to this major food poisoning incident Snow Brands president Ishikawa resigned from his post (The Japan Times, 2000). Company announced to form a joint venture under a single brand with Japan's Tobacco Inc and Key Coffee Inc. Both these were Japan's leading beverage makers. The incident forced Snow brand to increase the focus on the quality aspect by developing technical capabilities. This was to enlarge its market on a large scale (Ota & Kikuchi, 2004). The incident resulted in a gap between the Snow Brand and the dairy farmers in Hokkaido who had been working together for years towards the progress of the dairy food product.

Snow brand earned a good reputation through good responses and flexibility in the market. The share of distribution channel for milk products held by Snow Brand was 82.3% for supermarkets 8.6% for retailers and 9.1% for school lunch programs (Ota & Kikuchi, 2004). Among the top milk products, sale of Snow Brands were high in supermarkets. Snow Brand faced lot of pressure to maintain an adequate share of sales with a competitive price in the market. Trade discounts and proper supply of products were important to have an advantage over the competitors. They believed in maintaining a low margin high volume business to retain its share in the outlets. It affected its production process. In 1999, Snow brand fell to the second place in the dairy market (Shuzaihan, 2002). It was for the first time for Snow brand to be beaten by its competitors. To again regain the top position much focus was not given to quality of the product which led to the contamination of the milk products (Shuzihan, 2002).

In 1999, they were the largest industry in Japan with nearly 7000 employees (Ota & Kikuchi, 2004). Even though there was tough competition, they became the number one dairy firm in the market. One of the main drawbacks during this period was that the employees were over confident regarding their business. They didn't know about the challenges the company had to face in the market. The only thing they knew was firm's strong establishment with a powerful brand image and a well known products. The management

also ignored the fundamental rules for food product safety. President Ishikawa's lack of sales and production experience was also a reason for the downfall of Snow Brands dairy products.

Snow brand incident made a great damage to the reputation build by a century of hard work and struggle (Nakao, 2002). This led to the resignation of top officials in the management level. Power outage, lack of proper sanitary management at the production plant of skimmed milk powder led to the food poisoning crisis. Failure to take necessary steps at the right time from the top management led to the disaster. Top management people always need to be aware of risk management (Nakao, 2002).

Snow brands response to the crisis was a failure because they responded too slowly, were reluctant to institute a full product recall and even more reluctant with the public. When company did communicate it dealt much more on the impact of financial performance and not so much on the suffering of the people who had consumed its contaminated products (Baker, 2005). Snow brand did not have a proper structure to respond in a crisis situation. Lack of communication and information transfer between the employees and the top management was the reason why they were unprepared to take a vital decision at the right time (Baker, 2005). They also made huge mistakes by covering up with irrelevant facts to the media. Snow brands reluctance to provide with the actual facts about the poisoning not only lost the customer trust on the firm's dairy product but also made a fear among the customers that such products would be unsafe in the future.

4.5.7 RECOMMENDATIONS

Taiki plant of Snow Brand was established with quality improvement plans and also with power outage control measure. Snow Brand decided for an organizational reformation to improve the product quality. Product quality and safety department was in direct contact with the president of the company (Nakao, 2002). A toxin test on the raw material used for the production on dairy product including skimmed milk was made mandatory by the Health Ministry at all milk producing plants. Installing Hazard Analysis and Critical Control Point (HACCP) or establishing sanitation guidelines was made compulsory in dairy firms to prevent further occurrence of a similar dairy crisis (Nakao, 2002).

Snow Brand should give emphasis to product quality, safety of consumers, conservation of environmental resources, participation in public welfare and should safeguard the rights of the worker. The firm should consider consumers as the most important aspect to increase the reputation of the firm and also to maximise the profits. In order to guarantee the quality and safety of a product, the firm should give much significance to CSR activities and also quality inspections should be there at all stages of production (Xiaohong, 2015). The rights and interests of the employees should be safeguarded since their behaviour has a direct influence on the quality of the product and on the reputation of the firm. Employees should have a positive passion towards work and they should have a right moral standard to work towards the success of the organization.

Protection and proper utilization of environmental resources are of vital importance towards the growth of the industry and also for the future improvement of the economy. The reputation and profitability of a firm is directly linked to the firm's involvement in the social public welfare. Participation in social activities is a way in which firms can return to the general public and thereby implement the CSR (Xiaohong, 2015). Business expansion should be in line with the capacity of the organization and also in accordance with the rules and regulations of the government. Unethical practices can hurt the reputation of the firm and can also affect the performance. Crisis can happen to any firm but the success of a firm depends on how well they are prepared to deal with the crisis. A proper and well planned crisis system will help a firm to reduce the losses and to prevent reoccurrence of such problems in the future. It is years of hard work, reputation and good credibility which helps to gain customer trust but it can be lost in a matter of time if the firm is involved in an unethical practice.

Summary: The four cases describe about the dairy firm and the risk involved in its supply chain. It also shows how the performance of the supply chain got affected by these risks. The effects and impacts it had on the supply chain activities are also explained. These four cases complete the second stage of the research approach. It leads us to the next chapter on the analysis of the four cases on the basis of the existing literature which has been already studied in the stage one. A matrix is also developed showing the various supply chain risks involved in the four cases and how it can be ameliorated with the help of proper supply chain risk management.

CHAPTER - 5

ANALYSIS OF THE CASES AND MATRIX DEVELOPMENT

5.1 OVERVIEW OF THE CHAPTER

This chapter analysis the four cases on the basis of the literature which we have studied in the chapter "Comprehensive Literature Review". A matrix is developed in the final section of this chapter which links the actual risks from the cases to the perceived risks from the literature review. It also explains how the dairy firms could ameliorate the risks and negative impacts by adopting right supply chain risk management strategies. The first section in this chapter deals with supply chain and its role in the melamine crisis. It explains how dairy supply chain was one of the reasons for the crisis and how it affected the network of partners in the supply chain. Second section explains how proper traceability can lead to better relationship and trust between partners in a supply chain. In the third section, analysis is on Japan's dairy crisis of 1955 and 2000 and how it influenced and impacted the supply chain network. Analysis of the cases and matrix development is the final stage in the three stage research approach.

5.2 SUPPLY CHAIN AND ITS ROLE IN THE MELAMINE CRISIS

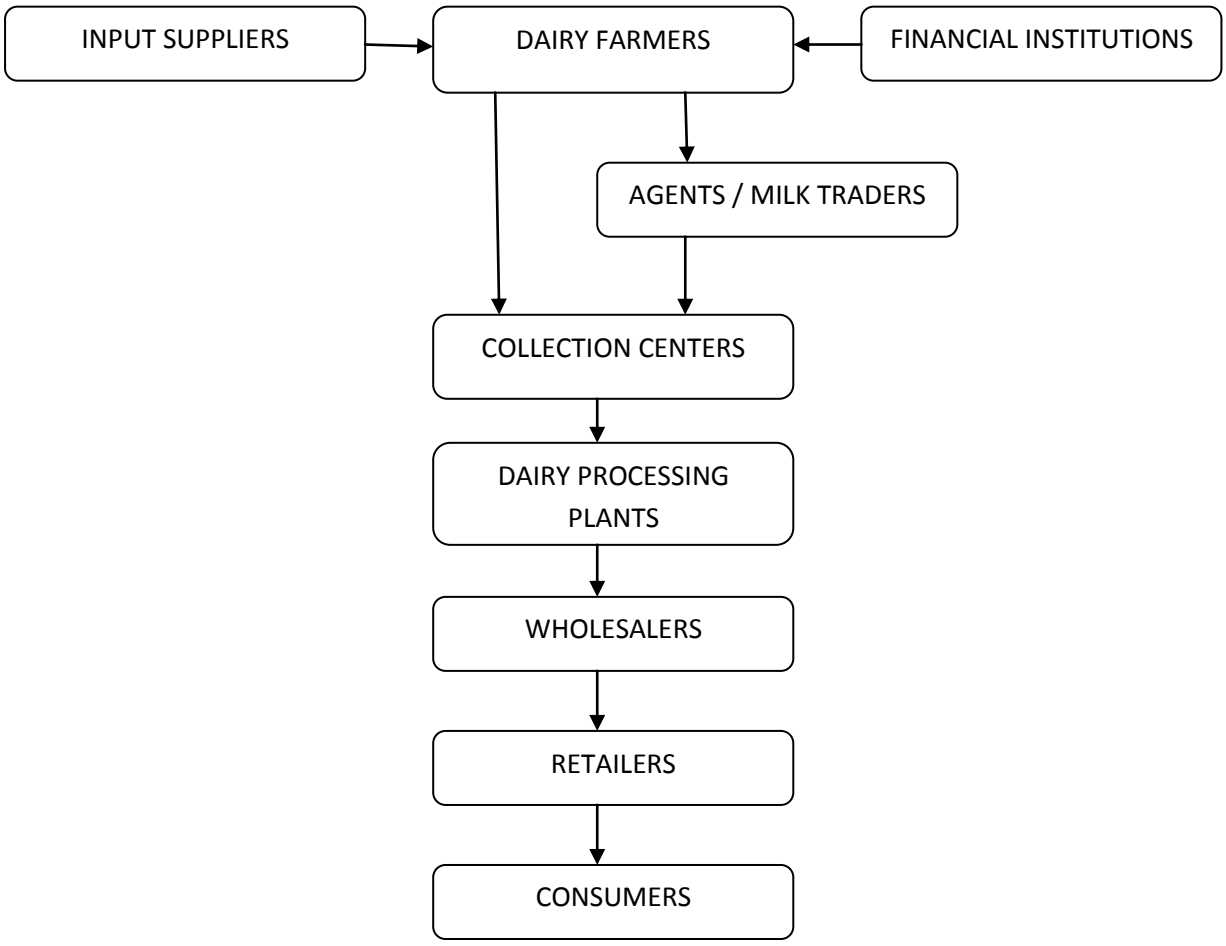
The output of milk grew fourfold from the years 2000 to 2007. The scattered small scale farmers were combined into the modern supply chain by Chinese dairy industry through innovative ways. Due to the Melamine scandal of 2008, the image of dairy industry in China faced severe blows. Investigations revealed that melamine, urea, vegetable protein and other protein powders were routinely added to raw milk (Gale & Hu, 2009). This was the practise that had been in the industry for some time. It is believed that the source of adulteration of milk which led to the melamine crisis of 2008 was done by the operators of milk supply stations in the villages, milk traders which act as a link between the dairy farmers and the processing firm and by the truck drivers who used to deliver the raw milk to the processing plants.

High competition and strong desire for rapid growth exposes the firm to such crisis. Firms have latest milk processing technologies and safety management systems in the plant but

most of the dairy firms gave emphasis to its supply chain which links a number of small and medium scale dairy farmers in the remote regions, milk traders and milk supply stations. The dependence on small scale farmers and traders reduced cost but there was no control over monitoring quality and standardisation of products. In 2007, there was intense competition among firms for limited raw milk supplies and this led to the adulteration of milk.

A twisted network of milk traders and truck drivers were acting as an intermediary between the milk station and the processing unit. There was a pyramid like structure of agents who collect milk from the rural dairy farmers and remote milk stations and pass it to a higher level milk trader who consolidate the milk from different sources and transport it to dairy plant for processing (Gale & Hu, 2009).

Figure 7: Network of a dairy supply chain



A delay in raw material supply can affect the whole dairy business. The reputation of dairy firm is badly influenced when met with a quality crisis or not meeting the standards of a

particular country. A close relationship between the dairy firm and their suppliers will help in better coordination and proper flow of products from farmers to consumers. Dairy firms send their own milk trucks or third party trucks to collect raw milk from villages and from other rural farmers. Firms have also set up milk supply stations to collect milk from individual farmers. There are also intermediary agents and milk stations to collect milk from village stations before sending it to the processor. There are hired managers to manage the milk stations. From the dairy farm the raw milk is send to the collection stations and from there to processing plants to make various dairy products. The finished dairy products are then sent to the wholesalers, retailers until it reaches the final consumer.

Rapid expansion and fierce competition in consumer markets reduced the retail prices in 2000. Milk production was reduced during 2007-2008 and this led to the rapid increase in prices. Retail price also went up towards the end of 2007. The competition became extreme at all levels in the supply chain. The industry's rapid expansion scheme led to the crisis in 2008. During this time there was a 15% increase in China's milk output which further increased the price of milk even though there was an increase in demand. The national development and reform commission noted (NDRC, 2008) that the firms excess capacity in milk production and the aim of blind expansion was the main problem in the industry. In contrast to the declining domestic prices the price of imported milk products were rising at this time. Dairy farmers being a part of the supply chain got badly affected since they were receiving a downward trend in their prices largely due to the pressure to reduce the prices. From 2002 to 2006, the average milk prices received by the farmers were remaining constant (NDRC, 2008). In 2007, the export of dairy products from China got doubled and demand continued to grow.

Economic condition and market structure can influence food safety. Increase in competition for raw milk and price fluctuation was some of the reasons for adulteration. The dependence on small farmers and independent milk stations reduces cost, increases flexibility in the supply chain but quality, safety and traceability have to be sacrificed. Government can control price fluctuation and competition in the market by controlling the prices and by regulating the market participation. NDRC adopted a mechanism for setting raw milk prices. Measures to deal with melamine crisis included the dairy firms to control the raw milk collecting stations, to procure milk form own farms, cattle milked in animal

husbandry zones, protection of small and medium farmers and proper control over milk traders.

Pricing is an important function in the dairy market. Price fluctuation has a negative impact on the supply chain activities. When the procurement price is fixed firms refuse milk, which are not up to the quality standard. When the demand is strong rigid prices can lead to shortages and farmers are denied from a share of high profit. Excluding the small farmers from the supply chain is an unrealistic decision from the management because majority of the dairy farms in China is owned by small farmers. Small farmers depend on the dairy sales for their day to day income. It is important to safeguard them, increase the scale of their operations, technical knowhow and their market power in the supply chain. Market power can be increased by allowing them to open independent cooperatives, providing them with subsidies for cattle feed and these farmers should be given the right to decide the price by forming a union or a cooperative (Gale & Hu, 2009). Such a process will provide the farmers with an upper hand when negotiating with the dairy firms.

5.3 TRACEABILITY FOR BETTER RELATIONSHIP AND TRUST IN FONTERRA'S SUPPLY CHAIN

New Zealand's dairy supply chain has to face many risks when compared to other products supply chain. There are number of reasons why Fonterra is vulnerable to various supply chain risks.

- Recent expansion of dairy exports to various other countries.
- There are geographic barriers to traceability.
- When the product leaves New Zealand it has to go through an unfamiliar supply chain and a good traceability cannot be developed.
- Milk can be easily prone to bacterial risk since it's highly perishable.

The ability of an organization to track goods in an efficient way across the dairy supply chain is known as traceability (Mercer). Product traceability is achieved through developing relationships and it flourishes only when there is adequate trust between supply chain partners (Tejpal et al, 2013). If there is good relationship, information can be shared from

raw material input to the final consumer goods. This information sharing is the main role in the supply chain (Chu & Lee, 2006). One of the ways in which efficiency can be increased by minimising the risk in an organization is by adopting proper product traceability in the supply chain. High traceability is a vital tool to minimise a risk. So traceability is very important for a supply chain of a product which involves human consumption. An efficient traceability tracks the downstream activities as well as the upstream activities in a supply chain. Products should be tracked from the origin of its raw materials until it reaches the final consumer for a successful and effective traceability.

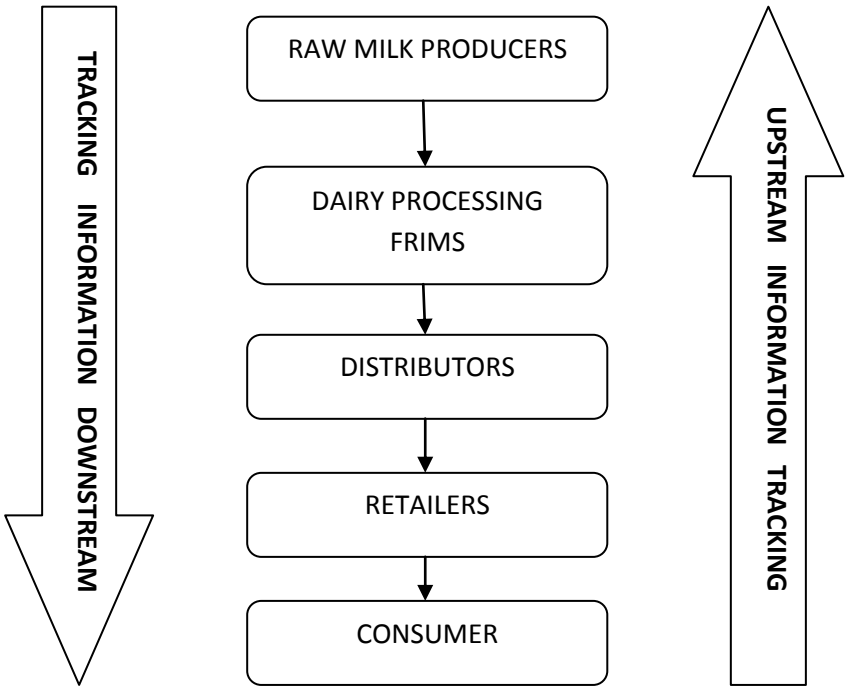


Figure 8: Traceability in a dairy supply chain

Fonterra exports 95% of its milk production. So Fonterra's role is clear in the international market. Traceability is difficult in a firm's supply chain once the products are exported from a country. While exporting a dairy product, it has to go through different processes and firms such as third party logistics firms, customs department and overseas dealers which add complexity and risk to the supply chain operations.

Traceability in supply chain did not function properly in Fonterra. Fonterra was unable to see the ill practices because of the lack of proper dealings they had with their supply chain partners. They could have avoided the risk if they were able to observe the quality of

production at each stage. Once the product leaves the production plant it is impossible to check the malpractices. If Fonterra had the capacity to maintain the quality, it would have benefited not only Fonterra's reputation but also the image of the entire New Zealand's food manufacturing sector (Van Woerkum & van Lieshout, 2007).

WPC 80 recall is a good example of how Fonterra needs to set up an effective relationship across their supply chain (Norris et al, 2013). An increase in the traceability process would allow Fonterra to trace down the contaminated products faster and thereby reducing the damage caused by the intensive media coverage. If Fonterra had an effective traceability and a better crisis management plan they could have responded much better to deal with the crisis.

So, traceability is a vital element of supply chain if a firm wants a smooth flow in supply chain network. Traceability can be achieved by developing sound business to business relationship and trustworthiness. Fonterra lacked to maintain a healthy relationship with its supply chain partners which led to the crisis. In Fonterra, supply chain was vast and there were geographical barriers for proper relationship, trust and traceability with supply chain partners. Fonterra botulism highlighted how easy it is for dairy products to get contaminated and how badly it can affect the reputation of the firm. If they have paid attention to traceability it would have prevented a contamination occurring as Fonterra could see what the downstream players were doing more clearly and would have helped to locate the contaminated products, thereby improving the reputation of the firm.

5.4 SUPPLY CHAIN AND JAPAN'S FAMOUS DAIRY CRISES OF 1955 AND 2000

Among the most dreaded situation for any milk producing firm is the outbreak of a food poisoning. Japan's famous dairy firms such as Morinaga and Snow Brand had to face severe blows during 1955 and 2000. High competition and strong desire for rapid growth exposes the firm to do unethical businesses which can lead to food poisoning. The reputation of a dairy firm is badly influenced when met with a quality crisis. Profit orientation and mass production always result in quality deterioration and reduces the safety of the product. In 1955 an industrial grade sodium phosphate which contained arsenic were added to the milk products which was not examined for purity or fitness for human consumption. It was used as a stabilizer to maintain the quality of the raw milk. Morinaga crisis happened when Japan

was in its prime economic growth. The crisis was a setback on the image of Japan's growth itself. Firm's which ignore the quality control measures, safety standards and raw material assessment are bound to face such food poisoning disasters.

Japans dairy giant Snow Brand was shattered to its roots in the year 2000. The original cause of the poisoning was due to a toxin generated by increased bacteria during a power failure in the processing plant. There were many unethical practises which led to the contamination. The firm violated many food regulatory laws, there was no proper sanitation, there was lack of awareness about crisis management and the person in charge had no expert knowledge about technology or production. The crisis affected the image and reputation of Snow Brand which was built through years of hard work and struggle.

When discussing the Morinaga crisis it had many international impacts as well. The government failed to take an adequate food safety measure even after the Morinaga crisis. The government also failed to give support or compensation to the victims. Very little attempt was done to spread the news outside Japan as it was not published well by English scholars. Even in articles and documents the information about crisis was not well reported and due to these reasons world was not much aware about this particular crisis.

Risk has a relationship with trust, communication and information sharing in a supply chain network. Risk of betrayal can ruin the relationship between supply chain partners and can break the level of trust between the partners in a supply chain. Everything is interrelated in a supply chain network starting from the raw milk procurement from the dairy farmer to the end consumer. Risk can be reduced when there is a stable supply chain network. Stability in a supply chain can be achieved by maintaining a healthy relationship with the raw milk suppliers and with the intermediaries between the raw milk supplier and the dairy firm. In the case of Morinaga, consumer trust was lost and firm didn't pay any attention to communication and information sharing. They blamed the medical company for deceiving them against the principle of trust. Morinaga was not in good terms with the customers and they kept all the information very private.

To maintain a proper flow in the supply chain, the first step is to maintain a total quality management. There should be a risk management culture within the firm. Risk management culture should extend beyond the boundaries of corporate risk and firm's management and

should be incorporated in the supply chain network. Nothing is possible without a proper leadership and direction from the top management. Supply chain risk assessment should be the formal part of the decision making process at every level in a supply chain. A supply chain risk management team should be created within the business. They should regularly update the supply chain risk register and issues should be reported to the supply chain board of directors and this should be done frequently. A risk assessment should be prepared for better handling.

In Japans dairy crises, the main problem was firm's lack of internal ability to produce quality products which affected the smooth functioning of the supply chain. Firm's internal abilities comprises of product quality, value added activities, maintaining the safety regulations and meeting the standards set by the government. These processes are linked with the firm's internal assets, network, transportation, infrastructure and communication. Inadequate information on the future supply, raw material quality, transportation, and quality of finished dairy product can also lead to a risk. Disruption to any of these activities imposes a risk on the supply chain network and on the firm.

5.5 INTEGRATING THE FINDINGS

INTRODUCTION

In this section, various kinds of supply chain risks which led to the dairy crisis have been discussed. A **matrix** is developed to show the different risks in each dairy crisis and how these risk impacts can be ameliorated with the help of proper supply chain risk management. Further explanation with regard to the risk, its association with each case and how it can be properly managed is provided later in the chapter.

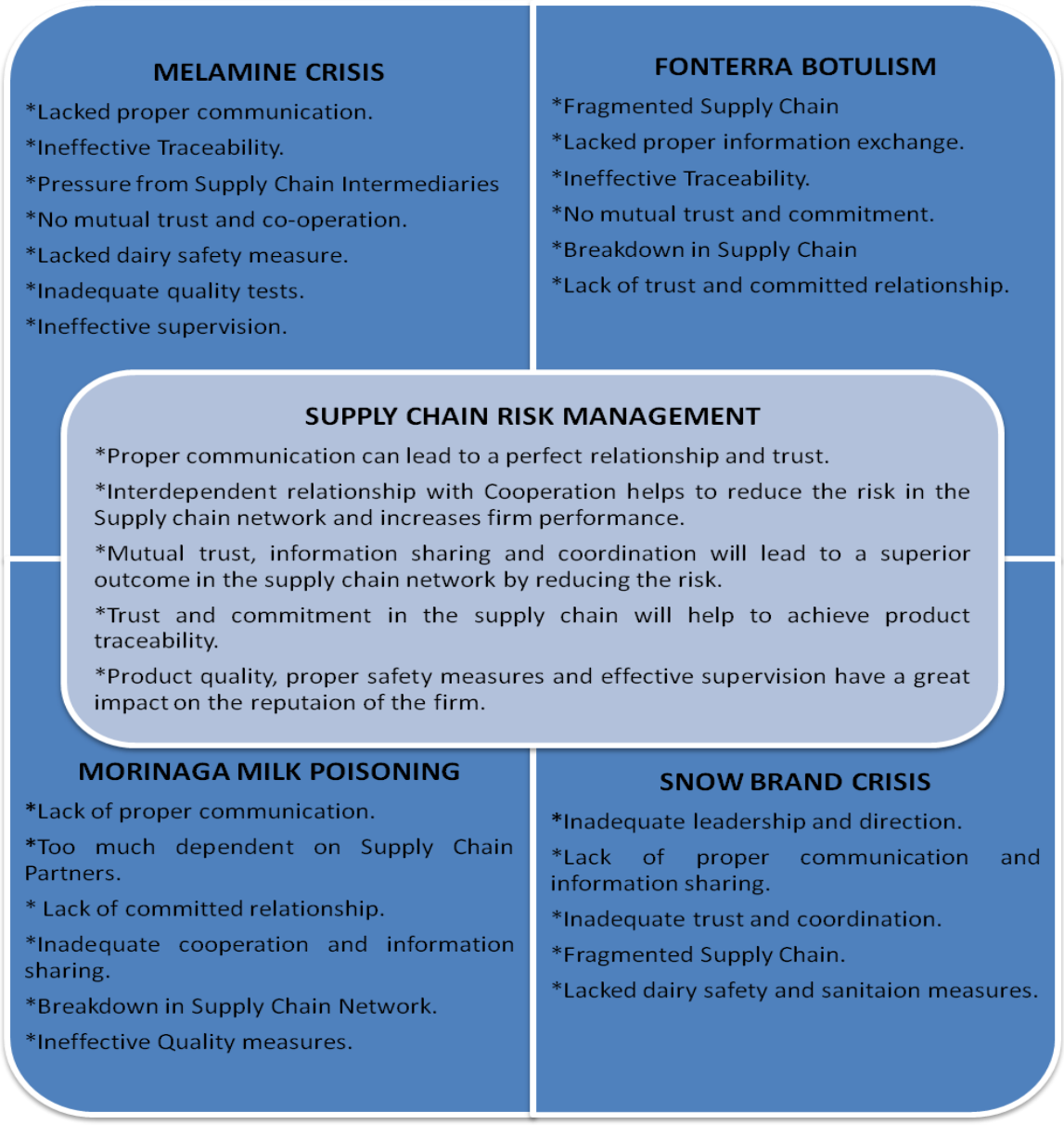


Figure 9: A matrix showing different supply chain risks and ways to ameliorate it with proper supply chain risk management

On **analysing** the data, I came across various reasons which affect a smooth functioning of supply chain and I have discussed various ways to mitigate the negative effects. In a dairy industry, safety and quality of the products are of prime importance. A risk management strategy will ensure safer products for the consumers and will protect the reputation of the firm. It will also reduce the risk in the supply chain network and minimise the risks associated with the processing of the products.

A supply chain focus is necessary for long term well being of any dairy firm. There should be a close link between the raw material suppliers, manufacturer and end consumer which improves the quality of the product and performance of the firm. For an effective supply chain performance and reputation the manufacturing firm and supplier need to adapt to certain situations. Adaptation can be vital for the conduct of the business, relationship maintenance and long term performance of the partners. Mutual trust and information exchange and coordination lead to a superior outcome in a supply chain network. Frequent quality tests, food safety technicians, management technicians, skilled laboratory staffs with adequate knowledge are important for a proper functioning of a supply chain. As discussed earlier, Melamine crisis lacked most of the above food safety measures and it lacked proper supervision. Melamine scandal was a bad example of proper crisis management and information clarity. Sanlu group refusal to take responsibility further increased the risk in supply chain.

Fonterra study revealed that how safety and quality of milk can have a huge impact on the world market prices of dairy products and on the reputation of firm. Supply chain management can be built on the foundation of trust and commitment. Product traceability is achieved through good trust and commitment from the network partners. A good relationship in a supply chain can be attained if information can be shared from raw material procurement to dispatch of final products to the customers. The research on Fonterra showed how traceability played an important role in supply chain management. A proper traceability in the supply chain could have reduced the risks. Traceability can be achieved only by developing sound business relationship and trustworthiness.

Morinaga milk poisoning and Snow Brand crisis disclosed that profit oriented and mass production will result in deterioration and reduces the quality of dairy products.

Cooperation between supply chain network partners can challenge a proper risk management. A delay in taking a right decision at the prime time will affect the whole business process. Reputation of a firm is badly affected when the quality of the product is not given much importance. Risk has a relationship with trust, information sharing and proper communication with the network partners. Risk of betrayal can ruin the relationship between the supply chain partners and can break the level of trust. This is true in the Morinaga milk case were they blamed the medical company for deceiving them against the principle of trust.

The data on Snow Brand revealed that the efficiency of the management will lead to a smooth operation of the supply chain. The top management at Snow Brand ignored the fundamental rules for dairy safety and proper sanitation at the production plant. Top management should have a proper knowledge of risk management. To maintain a proper flow in the dairy supply chain, quality of the product plays a pivotal role along with proper leadership and direction from top management. A supply chain risk management team should be developed within the business.

The analysis of data identified three factors which are common for Sanlu and Fonterra which led to the risks in the supply chain:

- Fragmented Supply Chain – Most of the dairy supply chain network involves milk traders, village milk supply stations and farmers from remote and rural regions of the country. For example in New Zealand a typical farmer manages a herd of 375 cows and is wealthy (Dairy NZ 2010), where as in China most of the dairy production is produced by small traditional households with a typical herd size being less than 10 cows (Xiu & Klein, 2010).

- Pressure from Intermediaries – In China a milk processing firm's size gave it an enviable economic power with respect to each stage of supply chain through the farmer, milk collecting centre and raw milk dealers (Pavlovich, Sinha & Rodrigues, 2016). Farmers had little power to affect the terms of sale which affected in their profitability. Association was formed between the dairy farmers and milk dealers for better price from large dairy processing firms. In New Zealand the farmers communicate directly with Fonterra. The large numbers of small scale independent

farmers and traders restricted the quality control of products with no additional measures such as goodwill with small farmers was introduced (Lohmar et al, 2009). As a result the quality of milk supply was not guaranteed.

- Breakdown in Supply Chain activities – The use of local milk supply chain by Fonterra and Sanlu occurred in the absence of national standards in China for quality control (Pavlovich, Sinha & Rodrigues, 2016). On supply side the processing firms could delay the payment to farmers even when the feed cost was rising (Gong, 2008), so the farmer's naturally used poor quality fodder which impacted the protein content of milk. Dairy firms paid less attention to quality. The inadequate internal quality control practices made the dairy firms to use Melamine and other protein powders such as urea and vegetable proteins and thus contaminating Sanlu's milk products.

Literature review shows that lack of co-operation between the supply chain network partners can challenge a proper management of risk. Dependency has also a role to play in the management of risk. When a particular firm is too much dependent on another network partner for its operations it is more exposed to supply chain risks. Risks are not easy to manage once it has occurred. Critical events and impacts can influence the organization, the people and the brand itself.

Mutual trust between the channel partners has a superior role in the supply chain network. When there is trust and cooperation, expectation starts growing and this develop a positive relationship in the supply chain performance. Supply chain management is built on the foundation of trust and commitment. Trust can be explained as the belief that the other partners action would end up in a positive outcome. The firm - supplier relationship can be strengthened and made successful through intense, diverse and frequent communication between the network partners.

In a supply chain, communication can be termed as a link that holds the partners together. Mutual information sharing and communication between the partners and frequent information updating among the partners are a prerequisite for an effective supply chain outcome. Communication and trust has a positive relationship which results in a competitive advantage for the firm. When there is increased trust and communication, this will lead to a greater cooperation, reduces uncertainty, minimise monitoring of contracts

and willingness to share risk. Communication allows the partners to convey essential information up and down the chain and thereby helping in a proper decision making, joint problem solving and better understanding the customers. Firms do benefit by building a close and interdependent relationship with the suppliers.

In a supply chain network it is usually a department or a person in charge who does the communication on behalf of the firm with the suppliers. Communication among the firms in a supply chain can be influenced a lot by personal relationship of the communicating employees. Such a personal communication between the employees and supply chain partners can impact towards the success of the supply chain activity.

Summary: The final stage of the three stage research approach focuses on the analysis of the four cases. A matrix is developed which links the actual risks with that of the perceived risks. It also explains how the risks can be avoided by the dairy firms by proper supply chain risk management. More discussion on the analysis of the cases with respect to negative aspects which can lead to a supply chain failure and what are the positive factors which can be adopted by the firms to increase the performance of the supply chain activities has been explained in the next chapter.

CHAPTER - 6

DISCUSSIONS AND CONCLUSION

6.1 OVERVIEW OF THE CHAPTER

The chapter deals with further discussion on the four cases. Negative aspects which led to the risks in the supply chain and how it influences the performance and also how the dairy firms across the globe could adopt few success factors for a better supply chain performance have also been explained. The chapter ends with a conclusion for the whole research paper and also by pointing out the implication for future research.

6.2 DISCUSSIONS

The literature based research focused on the supply chain risks in a dairy industry and how the negative effects can be ameliorated with proper supply chain risk management in order to increase the supply chain performance and reputation of the firm. The role of trust, relationship between partners and communication in a supply chain forms the nucleus of the research as these are the most important aspects for a proper management of supply chain risks. The study as mentioned before is divided into three main stages. Each of these stages is interconnected and leads to the next one.

In the first stage existing literature related to supply chain risks, how dairy firms perceive it, various kinds of supply chain risks in a dairy industry, supply chain risk management stages and strategies which can be adopted and how these risks can be minimised for a superior performance and for a greater reputation of the firm are studied in detail. The review of the literature is used to discuss and explain a conceptual model for supply chain risk management that is then used to examine four cases of supply chain failure in the dairy sector. In the second stage of the research approach, four cases related to supply chain failure in a dairy firm has been described and analysed in detail. In the final stage a matrix is developed by linking the supply chain risks studied from the existing literature with that of the actual supply chain risks from the four dairy cases. Various ways in which the firms could have minimised the risks or ameliorated the negative effects have also been looked upon.

Supply chain is of growing importance in the modern day business. As the organization expands locally and internationally the supply chain division of the firm also expands at a faster pace. Such an expansion leads to numerous risks in its supply chain activities and between the supply chain partners. These risks can lead to a negative effect on the organization if not managed properly. A crisis in the organization also has an impact on the supply chain activities and performance. The ever growing risks related to a supply chain can reduce the performance and can also affect the reputation of the firm.

The review of the existing literature revealed that very little research has been carried out on how to ameliorate the negative effects of supply chain risks in a dairy industry. Lack of application of the study from a communication, relationship and trust perspective on dairy industry's supply chain risk is one of the reasons which inspired me to conduct the research. In today's uncertain markets, supply chain risk has become an issue of significance for many dairy firms. Due to global sourcing, supply chain network has become more complex and thereby increasing the risk. Desire for greater growth and increased production has the risk and issues in the supply chain. Firms need to assess the risk and manage them from different perspectives in order to be successful. Creating a better and resilient supply chain network helps to manage and mitigate the risks in a proper way.

Developing a right supply chain relationship between the partners will help to increase the trust and performance aspect of the dairy firm which has a direct influence on the reputation of the firm. Proper communication between the firm and supply chain partners will help to understand the complex supply chain issues in a better way, helps to gain trust, minimises misunderstanding and conflict situations. On analysing the four cases, each of the dairy firms had its own risk factors which led to a negative effect on its supply chain performance. In the case of Melamine crisis, the dairy firm lacked proper communication between the supply chain partners and between the various departments in the organization. Product traceability being one of the most important criteria for a superior supply chain performance was ineffective. Pressure from intermediaries on the other supply chain partners was yet another risk factor which led to the melamine crisis. There was no mutual trust and cooperation between the partners which further aggravated the situation. Inadequate quality tests, dairy safety measures and ineffective supervision were some of the other factors which led to the melamine crisis. Meanwhile Fonterra had a fragmented

supply chain which led to numerous risks in their supply chain activities. Ineffective traceability of its products in the domestic and international markets made its supply chain activities very volatile and at high risk. The supply chain partners and Fonterra had no mutual trust, commitment or a proper healthy relationship. Lack of information sharing also led to the breakdown of supply chain activities.

In the case of Morinaga milk poisoning, the dairy firm was too much dependant on the supply chain partners. Too much dependency can increase the risks associated with the supply chain and can breakdown its activities. Factors such as lack of proper communication and committed relationship also led to the milk poisoning crisis which further affected the performance and reputation of the firm. There was also inadequate cooperation between the supply chain partners and the dairy firm. Snow brand dairy firm had a fragmented supply chain like Fonterra. A fragmented supply chain is prone to many risks and it can breakdown easily. Along with that, factors such as lack of information sharing, trust and ineffective coordination led to the negative situation at Snow Brand. The dairy firm also lacked proper dairy safety and sanitation measures. Inadequate decision making, leadership and direction further made the situation worse for Snow brand by affecting its performance and reputation of the firm and brand as a whole.

A proper supply chain risk management would help the dairy firms to ameliorate or mitigate the negative effects that the risks have imposed on the supply chain performance and reputation of the firm. Proper communication can lead to a perfect relationship and trust. Interdependent relationship with cooperation helps to reduce the risks in the supply chain network and increases firm performance. Mutual trust, information sharing and coordination will lead to a superior outcome in the supply chain network by reducing the risk. Trust and commitment in the supply chain will help to achieve product traceability. Product quality, proper safety measures and effective decision making has a great impact on the reputation of the firm.

Dairy industry is one of the growing and revenue generating industries for countries like New Zealand, China and Japan. Studying the risks in supply chain of a dairy industry will eventually help the dairy firms all over the world to manage the risks in a better way and thereby increasing the performance and reputation of the firm. The study will help to create

a proper trust based and healthy relationship between the supply chain network partners which will eventually reduce the risks in the supply chain. The research will be useful for supply chain managers for effective communication with various supply chain partners and also for better handling of negative effects in the case of a crisis situation. Proper communication, prior planning and vital decision making from the supply chain managers will help to ameliorate the negative effects and thereby improving the performance and reputation. The study will also add to the existing literature on effective supply chain management and risk management. More discussion on the findings from the four case analyses and a brief description on the success factors for a better supply chain performance have been provided in the next two sections.

6.2.1 NEGATIVE ASPECTS WHICH LED TO THE RISKS IN THE SUPPLY CHAIN

There are various risks in a dairy supply chain which can be categorised as high, medium and low risk. Cost of production increases if the farmer owns a low milking cattle which brings down the production. This is considered as a direct impact on the performance of the milk producers. It can affect the level of procurement of the dairy firms. Lack of education creates problem in understanding the norms and standards set by the government. This can affect in the quality standard of the raw milk and also can increase the cost of production. Farmers incur losses when they do not receive adequate price for their raw milk production. It can incur huge losses, makes them bankrupt and also forces them to sell their healthy milking cows. Non-remunerative price of milk can be a risk for the whole supply chain cycle. A delay in the flow of raw milk from the producers to the processing plant has a direct impact on the production of processed milk. A delay in the out bound logistics can deteriorate the quality of the processed milk and can lead to perishability of the product. It can hamper the distribution process and can lead to customer dissatisfaction. In a dairy industry the logistics of raw material and of finished products are taken care by third party logistics firms.

Power outage, fire or accidents can be termed as hazard risks. These risks are considered to be high risk and can cause contamination of dairy products as in the case of Snow Brand. When the consumer demand is difficult to predict it can put pressure on the milk production and processing. Milk being a perishable product, too many stocks in the supermarket

shelves can damage its quality. When there is higher amount of dairy sales through the counter, it makes demand predictability difficult. When a firm is faced with a quality crisis it can lead to customer dissatisfaction and lack of reliability on the product. It can affect the smooth functioning of the whole supply chain.

Total cost of production increases when there is a high price for the cattle feed and medicines. Inefficiency from the supervisors and managers to do their duties result in major risk for the firm. Quality assessments should be carried out at regular intervals with proper supervision at each stage of procurement and processing. Shortage of supply during particular seasons of the year can affect the reputation of the firm. Constant shortage of products makes the consumers dissatisfied and forces them to try competitor brands.

The 2008 **melamine** crisis in China reveals that adulteration of milk can be a very serious public health issue and shows a lack of proper food safety regulations in a country. Such a milk adulteration crisis is not only an issue related with the public health but also deals with various other serious impacts on the global economy, international food trade and also on politics. In fact, during the melamine crisis it was not only the infant milk products which were rejected globally but also other dairy and food products due to the presence of melamine from tainted milk. Even China being a home market for the product saw a decline in its sale. Also there was a decline in the dairy sale as a whole for all dairy brands. Chinese people see this melamine milk adulteration as a national shame even though it was just one single food adulteration incident.

The melamine crisis forced the government officials to take necessary action against the food and safety law violators. Top level managers and officials were fired from the organisation and also imposed high fine and imprisoned certain others. The government was forced to implement new food regulatory and health safety laws into force. Regular inspection of the food and dairy manufacturing plants were made mandatory without exemption. The crisis also reduced the allowable tolerance for melamine in milk products. Safety of the dairy products is the responsibility of all stakeholders and proper attention and awareness should be there to safeguard the health of the society. The Chinese government took the issue very seriously and even started to safeguard and support all the partners in a

dairy supply chain so as to provide high quality raw material, clean, safe and healthy dairy products to the consumers.

The association formed by the farmers as well as the milk collecting agents has an important role to play in the supply chain, so that the illegal adulteration of milk is prevented and discouraged. They should also strengthen the supervision across the procurement stages so as to make sure they deliver high quality raw milk to the processing firms. These associations should also bargain and fight for an improved price for their milk from the dairy processing firms. A smooth and effective system can be put into place by a right moral persuasion and awareness by the stakeholders. Confidence of the customers and supply chain partners can be improved by implementing proper information sharing and transparent decision making across the supply chain.

The safety of dairy products is the sole responsibility of the food manufacturers and government authorities. Dairy firms can assure safe and healthy products by being honest and credible in its actions and decisions. The dairy supply chain includes a long chain of partners ranging from dairy farmers to milk collecting agents to dairy processing firms. A safe and quality product is a combined effort of all the partners in the supply chain. Food and dairy industry should consider social responsibility with utmost importance and ensure safe products for the consumers. The rules, regulations and control system set by the government should cover the whole dairy supply chain without any possible gap. In melamine crisis, the raw milk collecting agents were the main culprits for the excessive adulteration of milk. There were no government rules or regulations to control the actions of these milk collecting stations.

A joint effort by both private and public would enhance a good food safety control. To build an effective supply chain, the first step is to train specialists to improve good agricultural practices and good manufacturing practices. HACCP should also be introduced in targeted areas. Priority should be given to strengthen the participation of small scale farmers in the coordinated supply chain.

New Zealand's dairy sector is not only famous for its export activities but also contributes to the country's reputation and identity. Risk events such as botulism crisis can have a negative impact on the world's largest dairy exporter. A local quality issue at one of the plants may

lead to a significant risk on the global arena if the risk is not managed well. Fonterra's experience with the botulism crisis made them realise the importance of proper risk management strategies, risk analysis, risk communication and the accountability that should be shown to the loyal customers. In a dairy industry, the safety and quality of the products are the number one priority for the firm. A risk management strategy will ensure a safer product for the consumers, protect the reputation of your brand, reduce the risks in the supply chain network and minimises the risk associated with the processing of the product.

The outbreak of food poisoning is the most dangerous situation for any dairy producing firms. Profit oriented and mass production will always result in deterioration and reduces the safety of the product. **Morinaga** dried milk poisoning occurred during the early phase of Japans rapid economic growth, during the post world war period. Japan's dairy giant, **Snow Brand** faced a crisis in the year 2000. Morinaga in 1955 added sodium phosphate to the milk as a stabilizer which resulted in an arsenic crisis. Arsenic is the cause of peripheral neurotoxicity. Morinaga crises have several international impacts because this serious incident was not well recorded by the government agencies. The Snow Brand milk poisoning was due to a toxin generated by increased bacteria due to a power failure at the plant. The bacteria which entered the production cycle were send to the next level of production without being discarded. Food poisoning caused a rapid decrease in the sale of Snow Brand dairy products.

Dairy safety considerations are crucial for a large scale production. For the smooth operation of the supply chain, quality of the dairy product is of vital importance. Consumers are the buyers of an enterprise and they are the most important stake holders. So the firm must guarantee product quality and safety. In order to make it into practise, the firm must safeguard labourer's rights and interests. This will enable the employee's to have a positive passion to work with high moral standards. Protection and proper utilisation of environmental resources are important for future improvement of the economy. Unethical practises can destroy the reputation of firm. Crisis may or may not happen to a firm but the success depends on dealing with the crisis.

Japan's dairy crises incurred huge losses not only for the firm but also for the government. This was mainly due to firm's response to the crisis was very slow and the firm's were really

hesitant to recall its dairy products. The firm also lacked proper information sharing and communication with the general public. Quality assurance should be the main focus of any firm's supply chain restructuring plan along with renewing corporate philosophy, customer focused management, enhancing corporate governance and restructuring risk management function.

6.2.2 SUCCESS FACTORS FOR A BETTER SUPPLY CHAIN PERFORMANCE

The following success factors can be adopted for a superior functioning of the supply chain activities in a dairy industry:

- The best way to gain customer loyalty is by segmenting customers and creating strong direct relationship.
- Customer feedback should be gathered and market opportunities should be located carefully.
- Value creation and product innovation helps to meet the ever changing market needs. Creation of value can be done by managing the supply chain partners interests, needs and activities starting from the dairy farmers to the end consumers in the best possible way.
- When entering international markets, firms should also leverage their core competencies.
- Innovative ideas, methods, effective decisions, resources and supply chain infrastructure which are successful in a particular country can be adopted in the overseas market as well.
- Partnership with an international dairy firm is a useful strategy for more funds, infrastructure facilities, market support and for distribution facilities. Such a partnership adds value and mutual benefits for both the firms.
- Pre-planned crisis situation recovery strategies will help the firm to effectively manage the risks, negative situation, minimise reputational damages and to maintain the vital customer relationships.

- In order to succeed in the international market, the firm should develop and decide on the success factors and strategies for adapting in a foreign market.

6.3 CONCLUSION

The various risks detected can directly or indirectly affect the effectiveness and efficiency of the dairy supply chain. The impact level of these risks can be categorised as high, medium, and low. Supply chain being an integrated process, the probability of a risk or the occurrence of an uncertainty at any level in a supply chain can place the whole system at stake.

Risk and uncertainty has been found out to be an indispensible part of a dairy firm's supply chain. Irrespective of the strength of the supply chain, the operational flow of the activities in the supply chain can be disrupted by the risks and by the negative impact it causes. Dairy products being perishable requires conditioned transportation and storage which further makes the situation more complicated in the supply chain. For example, milk and its derivatives are highly susceptible to perishability. Other reason which disrupts the growth and reputation of a firm are the processing plants lack in infrastructural facilities, skilled manpower shortage, outdated technologies, increased cost of production and high competition. Other risks which are associated with dairy supply chain are inadequate facilities for proper transportation of dairy products, damage and leakages during the shipment, delivering the products on time to rural areas and scattered dairy outlets. Logistics related risks alone account for more than 50% of the risks associated with the supply chain and it has a direct impact on the smooth functioning of the supply chain network.

The retailer will be at risk when there is an untimely delivery and an abrupt increase in the price of the dairy products. Such transportation issues and unexpected price increase causes inconvenience to retailers as well as consumers. Adulterated milk is always unable to meet the customer's expectations. When comparing the quality standards the price of the products is incompatible. Unskilled labourers in the dairy processing plants make the situation worse, since they don't have a basic knowledge about the production techniques and operations. All these factors directly or indirectly affect the performance and reputation of the firm. Since consumers have started to become more quality conscious and price

aware, the dairy firms had to upgrade the quality of the products to meet the expectations of the consumers. Such up gradation of quality made the products to become more costly. This price rise is adversary affecting the performance of the dairy firms.

The risks in a dairy supply chain can be tackled by undertaking a series of methods which will improve the performance of the supply chain and thereby increasing the reputation of the firm. Firstly, the dairy firm's capability to deal with the international and domestic competition should be strengthened. Resource efficiency tends to be much higher in small and medium scale dairy farms than in a specialised and large dairy farm. Such small and medium dairy farms should be encouraged to promote its business. This will lead to a better process quality. Secondly, dairy firms should optimise its products and services. Innovativeness which adds value to the existing product should be encouraged by the government authorities. Value added products will also help to differentiate the dairy products of different firms. Thirdly, there should be official attention for the milking process. Milk should be hygienically procured and properly preserved to maintain the quality. Fourthly, there should be adequate safety and quality practices throughout the dairy supply chain from farm to the shelves to the table. This is the most important safety step in a dairy firm.

Dairy products being highly perishable item, certain conditions must be followed for safe processing and distribution of the products along the firm's supply chain. Assuring a quality product should be the prime focus of the dairy farmers, processing firms and the dealers. An effective health and safety department and officials should be established in an organisation to monitor continuously the quality and safety of the products. Finally the dairy firms should ensure a safe distribution of dairy products to its valuable consumers.

Risks are unavoidable in any firm's supply chain and distribution activities. The success of proper risk management depends on identifying them in a right way and taking right decisions to control them. Identification of risk is easy as well as difficult depending upon the situation. Detection of risks starts in many ways. It could be a survey were the stakeholders opinion are taken into consideration, brainstorming, check list or work break down etc to generate list of the issues. Risk in a supply chain of a dairy firm can be explained in terms of its likelihood and severity. Likelihood is the probability that a negative event

might occur. The degree to which the risk event can cause damage to the supply chain performance is known as severity. The risks in a dairy supply chain are a highly sensitive issue to manage with. If it is not controlled properly they have a negative impact on the supply chain performance and can disrupt the smooth flow of activities. Majority of the risk situation can be controlled and prevented from getting worse with proper risk assessment and awareness. These are some of the positive points to be noted for an effective supply chain performance and for maintaining the reputation of the firm.

Identification of risk and its assessment are considered to be the most tedious task of a supply chain manager. An uncertain risk situation can decrease the performance of supply chain and can obstruct the flow of activities. In order to minimise the risk impact, the situation has to be identified and assessed as early as possible by implementing right supply chain risk strategies. The risks should be addressed on the basis of its intensity. High risks are critical ones and should be focused with much more attention and immediate action when compared to medium or low risks. Depending upon the intensity of the risks in a supply chain, they can be avoided, shared, transferred or minimised with suitable supply chain risk strategies.

6.4 IMPLICATIONS FOR FUTURE RESEARCH

The intent of the research was to provide a framework to manage the supply chain risks in a dairy industry and thereby to minimise the negative effects on the supply chain performance and reputation. It should be understood that the decision making process in a supply chain risk management is interconnected as well as interdependent with each network partner according to each event. Although the risk management appears to be complex in certain situation, it can be managed well if there is a constant flow of information, proper relationship and trust between the supply chain network partners. The framework on supply chain risk management highlights three main advantages. Firstly, it is a step by step approach and well supported by the literature on risk management. The framework aids the dairy firms to identify the risks, locate its sources, helps to understand its constituents and generate appropriate strategies to manage it. Secondly, the framework uses different risk assessment tools to evaluate the various dimensions of risk. Finally, a change in the environment or organization is reflected on the framework. The guideline or

strategies adopted will help the firm to evaluate and explore future uncertain situations as and when it appears.

Since risk in the supply chain is not a constant phenomenon, the framework acts only as a guideline for proper risk management. For effective management, the supply chain managers should modify the framework by adding or excluding the elements according to the event or situation faced by each firm. A team based management and evaluation of risk in a supply chain is always useful for a firm. A cross functional team come up with lot more creativity and provides diverse opinions to handle a risky situation.

The supply chain risk management framework will be fully beneficial and accurate only if the probabilities and consequences of risks are evaluated. Future researchers should focus on the aspect of probability of risk and its consequences. Techniques and tools should be developed to assign probabilities to negative events and to make evaluation of risk easier. In the future, as competition increases and market expands the supply chain of dairy firms will become lot more complex and face newer risks. Researchers should come up with innovative techniques to handle the complexity with newer risks. Future research should deal with how supply chain is affected by complexity of risks.

The current research mainly focuses on the influence of relationship, trust and communication on the supply chain risk management in a dairy industry. With the help of future research, other enablers such as flexibility, organizational learning, performance rewards and information systems need to be better understood on how they influence the process of risk management in a supply chain and how these factors help to have an effective supply chain risk management decision.

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